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CONTENTS

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IN THIS ISSUE

IT is well known that Greece experienced a severe famine following the occupation of the country by the Germans in 1941. Although conditions later improved somewhat, this country continued to have serious shortages of food throughout the war years. "Some Effects of Famine on the Population of Greece" by Dr. V. G. Valaoras gives some statistics on deaths and births during the famine period and also presents data on heights and weights of children which show that, as a result of their prolonged undernutrition, the children became both markedly underweight and undersized for their age. Infants and very young children apparently received fairly adequate food.

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A succinct and interesting paper, "Wartime Population Changes in the United States," has been contributed for this issue by Dr. Conrad Taeuber. "While fighting the costliest war in history," the author states, "the United States increased its population more rapidly than in prewar years. There was no active program for promoting this population growth, and no basis in past experience for expecting it to occur." Nevertheless, the author manages to bring into brief compass an enlightening factual description of wartime changes in birth and death rates and in rural-urban and regional distribution of the population. The possible significance of these demographic changes for the future is discussed.

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Four reports from the investigation on Nutritional Status of Aircraft Workers in Southern California have been published in previous issues of the *Quarterly* and have given our readers a mass of detailed data on the results of this study. In the current issue, the final paper in the series "A Conspectus of the Survey and Its Field" is presented.

Dr. H. Borsook and Dorothy G. Wiehl not only have summarized the findings of this special study but also have sought to suggest, on the basis of these findings and the results of many other studies, the present status of the evidence related to methods of diagnosis of mild deficiency diseases and to the important problem of determining the ill effects of such diseases or the benefits of "optimal" nutritional status.

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In the first part of the article "Urbanization in Latin America," published in the last issue of the *Quarterly,* Dr. Kingsley Davis and Miss Ana Casis attempted to explain why Latin America is more urbanized than other regions with similar paucity of industry. In the second part, published in this issue, Miss Casis and Dr. Davis discuss certain traits of the urban and rural populations in Latin America. This section is concerned mainly with rural-urban differentials in birth and death rates, age distributions, sex ratios, marital status, illegitimacy, and literacy. Pointing out that the trend toward urbanization shows no slackening, the authors believe that with further industrialization the cultural characteristics of the cities will soon become those of the rural population and that the gulf between city and country eventually will be no wider than in the United States today.

SOME EFFECTS OF FAMINE ON THE POPULATION OF GREECE

V. G. VALAORAS, M.D., D. P.H.[1]

A. VITAL STATISTICS DURING THE FAMINE

THE second World War and its evil aftermaths of occupation, famine, and civil disturbances have had a profound effect on the entire fabric of the population of Greece. Damages and losses in human life were great, not only during the short but costly war in Albania, in the Northern Frontier and the Island of Crete, but even more so during the occupation when another kind of unofficial war was always present. Most important of all was the country-wide famine of 1941-1942, which killed and disabled large masses of the population. The resistance movement and the civil war were only second in importance to the famine in inflicting heavy losses on the already depleted classes of young and middle-aged male population of Greece.

Unfortunately, the exact measurement of these losses is not as yet available for the country as a whole, and it is doubtful if ever it will be ascertained with any degree of accuracy. Civil registration of vital statistics was the first administrative procedure to be paralyzed immediately after the occupation. Furthermore, communications with the provinces became difficult and sometimes impossible during the occupation. All attempts to reorganize them were unsuccessful.

The following numbers, which are given as an example illustrating that period, refer to the twin cities of Athens and Piraeus (population 956,813 in the 1940 Census) where registration was kept at a satisfactory level. Marriages, births, and deaths are given for these two cities in actual numbers since their presentation in "rate form" would be subject to criticism because of the extensive

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migration of the population which occurred to and from Athens during that time. The data are given from 1940 which, with the exception of the last two months, may be taken as a prewar normal year for Greece. Unfortunately again, the data are not absolutely uniform because only the first three years refer to the

Table 1. Marriages, births, deaths, and natural increase of the population in Athens and Piraeus, 1940-1945.[1]

Year and Quarter	Marriages	Live Births	Deaths	Natural Increase
1940				
Jan.–Mar.	2,499	5,237	3,656	1,581
Apr.–June	1,492	4,093	3,224	869
July–Sept.	1,498	4,556	3,131	1,425
Oct.–Dec.	1,489	4,650	3,337	1,313
1941				
Jan.–Mar.	1,612	4,704	4,019	685
Apr.–June	1,378	3,867	3,897	− 30
July–Sept.	2,102	2,800	4,793	−1,993
Oct.–Dec.	1,686	2,353	13,487	−11,134
1942				
Jan.–Mar.	1,434	3,484	17,529	−14,045
Apr.–June	1,635	3,025	9,395	−6,370
July–Sept.	1,717	1,819	6,971	−5,152
Oct.–Dec.	1,766	1,935	6,916	−4,981
1943[1]				
Jan.–Mar.	1,517	2,459	3,112	− 653
Apr.–June	1,339	2,707	2,218	489
July–Sept.	1,722	2,968	2,251	717
Oct.–Dec.	2,112	4,180	2,398	1,782
1944[1]				
Jan.–Mar.		4,671	3,278	1,393
Apr.–June		5,272	3,533	1,739
July–Sept.		5,536	3,807	1,729
Oct.–Dec.		4,136	5,389	−1,253
1945[1]				
Jan.–Mar.		6,706	4,278	2,428
Apr.–May		3,580	2,011	1,569

[1] From January, 1943 onwards the numbers refer to the narrower area of the two cities which includes 72 per cent of the population of the former larger areas of Athens and Piraeus. In the graphs all the numbers beginning with January 1943 have been increased by 39 per cent to make them comparable with the previous data.

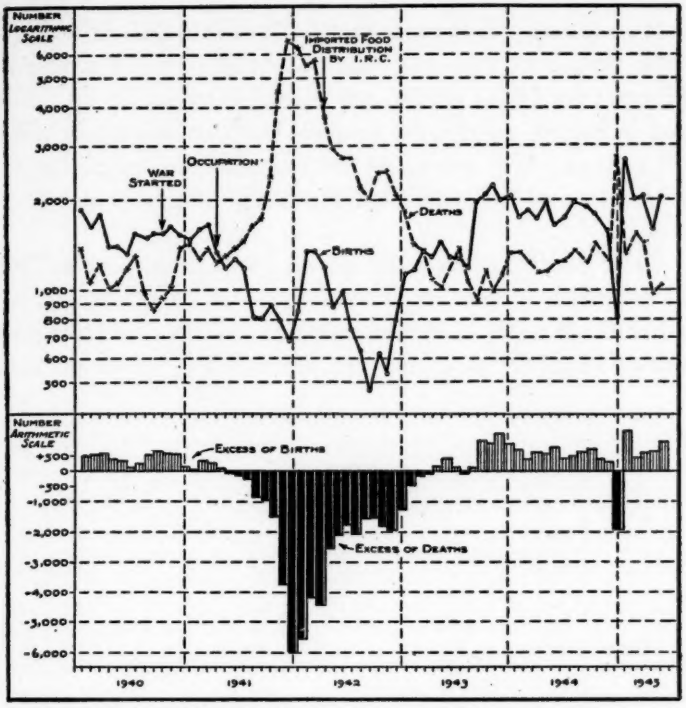

Fig. 1. Numbers of births and deaths, and excess or deficiency of births as compared with deaths in Athens-Piraeus, by month, 1940-1945.

above population. From January 1943, the data apply to a smaller area representing 72 per cent of the original population. Furthermore, the period from March 1944 to May 1945 is covered by the information collected by the Ministry of Hygiene which may differ from that of the Statistical Service. However, even with this crude presentation of the facts, some interesting points have emerged to show the dramatic repercussions of these historic events on the population of Greece.

In Table 1, quarterly totals are given for marriages, live births, deaths, and the natural increase of the population (births minus

deaths) during this five-year period which included the country-wide famine of 1941 and 1942. Monthly data are shown in Figure 1 for births, deaths, and natural increase. In this chart and in Figures 2 and 3, the numbers in the corresponding tables for 1943 and later years have been increased to adjust for the 28 per cent of the population for which data were not available.

Births which had exceeded deaths by an average of 400 per month began to decrease in numbers in the beginning of 1941, while the number of deaths increased rapidly. The two lines crossed each other in April 1941, the month in which the Ger-

Table 2. Numbers of deaths by age and sex in Athens and Piraeus, 1940-1944.

Year and Quarter	Males						Females					
	0–4 Years	5–19 Years	20–39 Years	40–59 Years	60+ Years	All Ages[1]	0–4 Years	5–19 Years	20–39 Years	40–59 Years	60+ Years	All Ages[1]
1940												
Jan.–Mar.	238	112	362	465	786	1,979	231	119	254	242	835	1,677
Apr.–June	325	125	366	367	588	1,781	308	113	249	222	541	1,443
July–Sept.	409	116	348	309	474	1,665	382	117	249	209	498	1,466
Oct.–Dec.	293	101	369	418	703	1,895	252	103	213	220	639	1,442
1941												
Jan.–Mar.	236	138	645	463	831	2,327	222	107	269	260	825	1,692
Apr.–June	352	147	604	443	666	2,250	297	105	294	247	692	1,647
July–Sept.	376	179	739	639	845	2,794	394	154	346	285	803	1,999
Oct.–Dec.	680	237	1,179	2,221	4,664	9,108	533	148	517	660	2,485	4,379
1942												
Jan.–Mar.	829	373	1,593	3,175	4,899	11,168	725	259	572	1,157	3,555	6,361
Apr.–June	454	343	1,028	1,545	1,803	5,225	461	301	525	836	2,006	4,170
July–Sept.	486	280	665	938	1,289	3,700	460	238	406	563	1,566	3,271
Oct.–Dec.	348	232	729	878	1,361	3,590	284	249	390	604	1,759	3,326
1943[2]												
Jan.–Mar.	153	117	365	377	574	1,616	119	124	261	225	761	1,496
Apr.–June	104	148	369	293	346	1,270	89	101	219	159	379	948
July–Sept.	163	118	325	267	360	1,233	152	98	209	200	359	1,018
Oct.–Dec.	151	126	400	302	369	1,348	157	98	208	183	404	1,050
1944[2]												
Jan.–Feb.	131	81	319	266	349	1,146	91	63	161	143	453	911

[1] Includes unknown ages.
[2] Figures are for restricted area of cities including only 72 per cent of the total population. (*See* footnote to Table 1.)

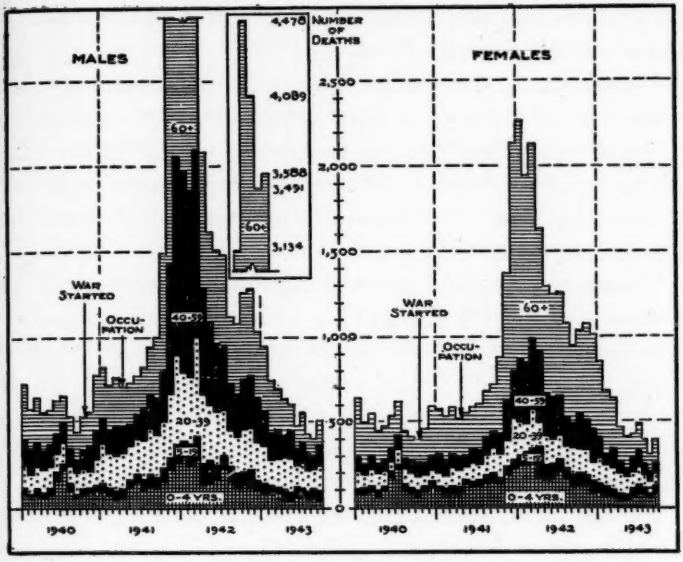

Fig. 2. Deaths by sex and age groups in Athens and Piraeus, 1940-1943.

mans over-ran the country. A few months later the deaths reached a peak six times higher than the normal, while births dropped to about one-third of the prewar level. Only after the arrival of the first imported provisions, which were distributed through the International Red Cross (April 1942), did the excessive mortality (mostly hunger deaths) begin to slow down. After a temporary increase in the number of births early in 1942, the downward trend in births continued until late in 1942. The two lines on their way to the normal did not cross again until March 1943, *e.g.*, two full years after their first deviation. During this period the deficit in births totaled about 14,000, or over one-third of the number of live births expected.

In December 1944, the month of the civil war, the two lines crossed once more, this time quite momentarily. It was due not so much to the erroneous drop of births — there were fewer

registrations not fewer births — but to the increased mortality in the war-torn area of the Greek Capital.

The decrease in the number of births during the famine period is attributed not only to the numerous miscarriages and abortions observed during that time, but mostly to a physiological sterility which perhaps affected both parents but was most evident in women. Menstruation was temporarily suspended in more than 70 per cent of adult females.

The sex and age distributions of the deaths are shown in Table 2 and Figure 2. Two striking facts come out of this comparison: first, the considerably lower mortality of the females which in some months of the famine period was only one-half that of males; and second, the relatively small increase in the mortality at young ages in comparison with the heavy losses inflicted upon more senior members of the community during the famine.

We can only conjecture an explanation of these interesting facts. It may be that the female is stronger and more adapted to sustain herself to the exposure of a long starvation or that the Greek family, with its traditional unity, was sparing the housewife by giving her additional protection.

Both these hypotheses seem to be real facts. Mature females, where the difference is mostly observed, may have derived a certain physiological protection from the absence of menstruation. An appreciable amount of energy was thus conserved, which enabled the organism to prolong life and eventually escape death. The other hypothesis of the family protection of women is reflected in the simultaneous protection of young children of both sexes whose mortality at the highest point was about three times the normal, while their mothers were succumbing at the rate of three to five times and their fathers were dying at a rate five to eight times the prewar level. An additional influence on the number of deaths of children under five years of age was the low birth rate in 1941 and 1942.

The primary factor in this excessive mortality of the Greek population was *starvation;* there was no other important epidemic complication as may be seen in Table 3 and Figure 3. With the exception of a small epidemic of typhus which occurred in the spring of 1942, and another of malaria which flared up a few months later, there was only a small increase in the mortality from infections and parasitic diseases which was due chiefly to an increase in deaths from tuberculosis. The same is true for deaths caused by diseases of the respiratory and digestive systems.

Table 3. Numbers of deaths in Athens and Piraeus of both sexes by cause (major divisions).

Cause	Month and Year (by Half-Years)								
	1940		1941		1942		1943[2]		1944[2]
	Jan.-June	July-Dec.	Jan.-June	July-Dec.	Jan.-June	July-Dec.	Jan.-June	July-Dec.	Jan.-Feb.
Infectious and Parasitic Diseases:	1,764	1,721	2,009	2,409	3,205	3,313	1,805	1,429	524
Typhoid	12	59	38	60	26	81	16	59	4
Typhus	—	—	—	—	42	11	—	—	—
Malaria	2	23	13	20	7	205	11	15	1
Tuberculosis	1,287	1,244	1,498	1,820	2,588	2,425	1,468	1,105	389
Respiratory System	907	622	910	1,226	1,681	862	486	288	253
Digestive System	580	892	756	2,240	1,425	1,966	294	578	89
Circulatory System	799	614	822	1,612	1,463	894	599	397	245
Nervous System	683	568	720	958	848	548	306	284	125
Genito-Urinary	434	391	438	964	868	604	268	215	76
Cancer	490	500	424	540	359	359	243	348	89
Senility	350	288	460	1,771	2,178	963	401	226	112
Violent Deaths	135	201	632	4,884	13,827	3,859	506	586	372
Ill-defined	240	243	347	1,053	624	279	204	102	62
Total Deaths[1]	6,880	6,468	7,916	18,280	26,924	13,887	5,330[3]	4,649[3]	2,057[3]

[1] Deaths from rheumatism and some other diseases are not given in this table but are included in the totals.
[2] Deaths in 1943 and 1944 are for only 72 per cent of the total population of Athens and Piraeus. (*See* footnote to Table 1.)

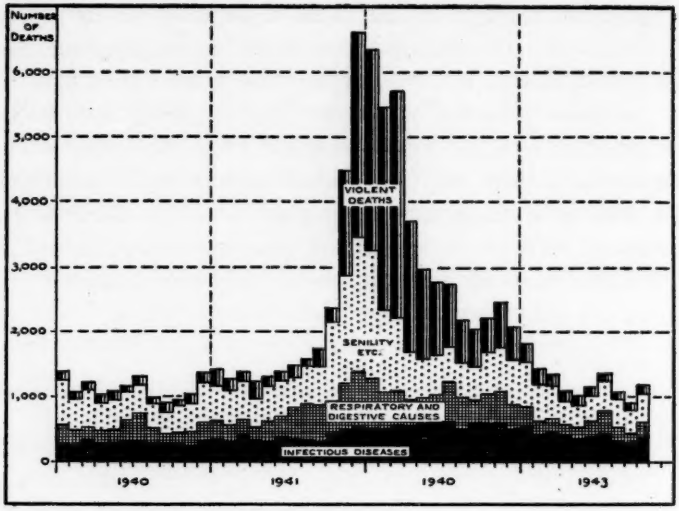

Fig. 3. Numbers of deaths by broad groups of causes in Athens and Piraeus, 1940-1943.

Hunger was the sole primary cause of death in tens of thousands of Athenians during that time. Deaths ostensibly due to heart failure, senility, etc., were in the great majority of cases expedited by the hunger famine of the period under review. This is clearly shown in Figure 3, in which the height of the ordinates representing the violent deaths — which include the hunger deaths — is greatly magnified during the famine period. This increase is accompanied closely by deaths from senility, etc., in which, however, the primary factor was again hunger.

The period of intensive starvation in Athens and Piraeus is examined more closely in Table 4 and Figure 4, which show the total deaths and deaths due to starvation occuring within the narrow limits of the City of Athens during successive seven-day periods from October 1, 1941 to April 28, 1942 together with the daily bread rations (the only food given at that time to the population) and the daily mean air temperature of Athens.

Table 4. Number of deaths from all causes and from starvation by seven-day periods, the daily bread ration, and the mean daily temperature in Athens during the famine period, October 1941 to April 1942.

Date of 7-Day Period	Number of Deaths		Bread Ration—Grams For Each Day of Week							Mean Temperature Each Day Centigrade						
	Total	Hunger	W	T	F	S	S	M	T	W	T	F	S	S	M	T
Oct. 1– 7	196	9	96	96	96	96	96	96	96							
8–14	228	10	96	96	96	0	0	192	128							
15–21	256	3	128	128	128	128	128	128	128							
22–28	254	9	0	160	160	160	160	160	160							
29–Nov. 4	292	7	160	160	160	128	96	128	128				15.7	17.3	19.1	17.5
Nov. 5–11	327	24	0	128	128	0	128	96	96	19.1	17.7	14.6	13.4	13.6	14.8	17.2
12–18	425	47	96	96	96	96	0	128	128	16.8	17.0	13.1	10.3	9.7	10.4	9.2
19–25	580	159	0	0	0	0	96	96	0	11.0	11.4	12.7	10.7	10.1	11.4	11.3
26–Dec. 2	791	313	96	0	0	96	0	0	0	7.4	4.6	3.3	4.7	6.2	7.4	5.3
Dec. 3– 9	967	408	160	96	160	160	160	160	160	4.5	4.3	6.1	6.4	4.6	10.1	13.3
10–16	742	267	160	160	160	160	160	128	128	8.4	10.2	11.5	10.3	9.6	9.6	11.2
17–23	566	150	128	128	128	128	128	128	128	12.1	12.9	15.5	11.5	9.5	6.4	7.2
24–30	641	196	192	192	192	128	128	128	128	6.8	10.3	10.7	−0.5	4.7	2.9	−0.1
31–Jan. 6	821	266	128	192	160	160	160	160	160	1.6	−1.4	2.8	0.9	2.3	5.2	9.8
Jan. 7–13	736	329	160	160	160	160	160	160	160	10.5	13.7	9.8	9.3	8.3	8.7	6.6
14–20	577	196	160	160	160	160	160	160	160	8.9	10.1	9.9	8.8	8.1	8.6	8.3
21–27	623	199	128	128	128	128	128	128	0	5.5	4.9	4.7	1.7	7.1	11.6	8.9
28–Feb. 3	823	370	0	128	0	128	0	0	0	1.8	2.7	5.1	5.0	7.5	8.0	7.3
Feb. 4–10	775	338	0	128	128	160	160	160	128	7.0	6.2	9.7	13.8	13.0	11.4	12.8
11–17	546	197	128	128	96	96	96	96	96	11.5	11.1	11.3	9.1	9.4	10.4	9.8
18–24	650	266	96	96	96	96	96	96	96	8.3	6.6	5.4	5.7	6.0	7.1	13.4
25–Mar. 3	684	277	0	0	96	0	0	0	0	14.4	12.2	13.7	12.9	10.7	11.2	10.5
Mar. 4–10	669	329	0	0	160	160	256	160	160	9.5	10.4	11.9	11.9	10.6	10.7	10.5
11–17	565	283	160	160	160	160	160	160	160	11.8	10.8	13.1	11.0	12.1	11.4	12.1
18–24	575	264	160	160	160	160	160	160	160	13.0	12.8	11.9	6.2	1.8	3.9	7.4
25–31	626	308	256	160	160	160	160	256	160	8.0	10.4	12.8	13.2	15.3	16.9	12.9
Apr. 1– 7	511	244	160	160	160	256	256	256	160							
8–14	399	203	160	256	160	160	256	160	160							
15–21	463	200	160	256	160	160	256	160	160							
22–28	403	174	160	256	160	160	256	160	160							

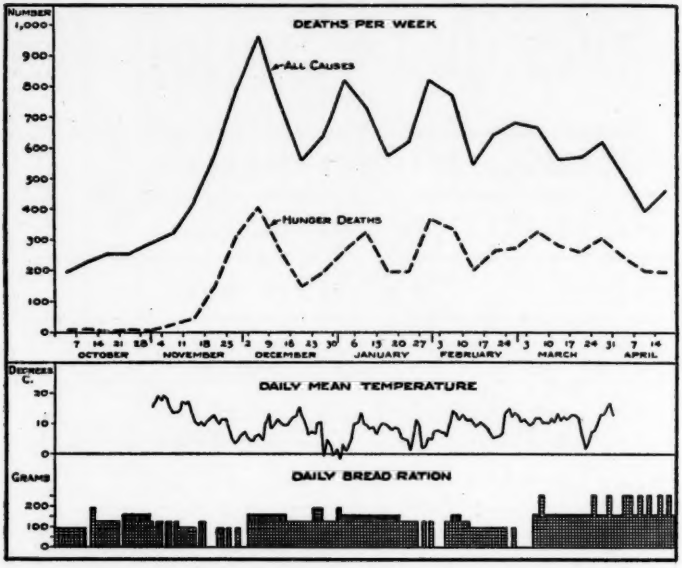

Fig. 4. Numbers of deaths by weeks from all causes and from hunger, the bread ration issued daily, and the daily mean temperature in the City of Athens during the period of acute famine, October 1941-April 1942.

It will be seen that the deaths take the form of successive epidemic waves with "hunger deaths" preeminent as the common factor. The peaks of these waves did not always coincide with each one of the frequent interruptions in the bread rations given to the population. Deaths, however, did coincide with the "cold waves" which are clearly shown in the lower part of Figure 4 by the line for the average daily temperature. The conclusion appears inevitable that the extreme undernourishment prevailing amongst the population in association with the drop in the air temperature resulted in a mass mortality of the starving and much weakened population. A caloric intake insufficient for normal weather conditions became grossly inadequate following the extra expenditure of energy during the cold spells.

During the two years of the famine the total losses from excess mortality and reduced natality in Athens and Piraeus exceeded 60,000 persons. If we extend this damage on equal terms for the country as a whole (in fact, many districts of Greece were more subjected to famine conditions), we estimate that Greece lost about 450,00 human beings because of acute privations resulting from lack of essential food during the early months of the German occupation.

The three main points of this war famine of Greece may be summarized as follows:

a. The acute manifestations of the famine lasted for two complete years (May 1941 - April 1943).

b. It affected adult males more than women and children.

c. It was not complicated with any severe epidemic or non-epidemic disease.

B. Post Famine — Somatometric Data on Children

A. *Height and Weight.* Somatometric data on the Greek population is so far scanty and mostly unreliable. The most authoritative source of prewar somatometric data is that of Professor Exarchopoulos and Miss Gedeon obtained from school children for the period 1927-1928. In their publication the mean values for height and weight are given on 50,000 measurements with no specifications as to the number examined in each sex-age group or the amount of dispersion of the observations around the mean. The mean values, shown in Table 5, are used for comparison with postfamine measurements.

In the second half of 1942 and the first months of 1943, in collaboration with Dr. Ser. Papaioannou, we made measurements of the body weight and the height of school children living in and around the capital area. We endeavored to collect a large number of measurements to ascertain the effect, if any, of the famine which was still prevailing in an attenuated form among the popu-

Age	Height—Cms.		Weight—Kgs.	
	Boys	Girls	Boys	
Birth	51.1	50.2	3.5	3.2
1	58.7	55.7	11.2	6.9
2	75.9	65.9	13.1	10.3
3	86.3	79.6	15.8	13.7
4	95.9	91.9	15.8	14.4
5	100.2	100.7	15.9	17.9
6	106.5	105.5	20.6	19.2
7	111.7	111.5	21.5	22.1
8	117.1	115.0	24.9	24.8
9	121.3	122.0	26.5	26.4
10	127.1	126.2	28.2	30.2
11	130.8	132.0	31.1	35.1
12	136.0	137.6	35.0	37.4
13	141.1	142.2	40.2	42.3
14	148.4	147.0	46.4	48.5
15	156.5	152.6	49.8	48.9
16	163.3	153.5	53.1	50.7
17	166.2	153.9	56.3	52.7
18	167.0	155.7	—	56.0
19	167.8	155.7	57.1	—
20	—	156.5	—	—

Table 5. Height and weight of Greek children, measured by Professor Exarchopoulos in 1927-1928.

lation. Unfortunately, the survey came to an end prematurely because of Dr. Papaioannou's departure from Greece, and data for only 9,461 boys and 4,972 girls were collected and analyzed. The results derived from these data have been incorporated in Table 6 with similar data derived from a second and more extended survey made one year later (1944) and from a third survey in Piraeus in the spring of 1945. The 1944 and 1945 surveys were made by a group of scientists[2] working under the auspices of the Institute of Social Insurance.

Comparison of the average heights of children measured in the

[2] This group consisted of Mr. M. Goutos, Director, Social Insurances; Dr. D. Orphanos, President, Panhellenic Medical Association; Dr. D. Stefanou, Director, Ministry of Education; Dr. G. Livades, Director, School of Hygiene; Dr. K. Choremis, Professor of Paediatrics, University of Athens; and Dr. V. Valaoras, Associate Professor of Hygiene, University of Athens.

Year and Age at Nearest Birthday	Boys							Girls						
	Number	Height			Weight			Number	Height			Weight		
		Mean	St. Error	S. D.	Mean	St. Error	S. D.		Mean	St. Error	S. D.	Mean	St. Error	S. D.
1942														
Birth	772	50.4			3.26			725	49.6			3.09		
1944														
1	3,949	71.2	0.1	5.4	8.88	0.04	2.38	3,710	69.9	0.1	4.9	8.04	0.02	1.23
2	1,997	82.3	0.1	6.0	11.56	0.04	1.72	1,871	81.3	0.1	5.8	11.10	0.04	1.68
3	2,194	90.7	0.1	5.4	13.62	0.04	1.88	2,006	89.5	0.1	5.3	13.16	0.04	1.76
4	2,737	96.7	0.1	5.4	15.38	0.04	1.93	2,485	95.9	0.1	5.4	14.95	0.04	2.00
5	2,788	102.4	0.1	5.6	16.86	0.04	2.09	2,697	102.1	0.1	5.5	16.52	0.05	2.11
6	2,448	108.4	0.1	5.6	18.62	0.05	2.24	2,555	106.8	0.1	5.6	18.10	0.05	2.32
7	1,335	112.3	0.1	5.4	18.76	0.09	3.03	1,333	112.8	0.1	5.8	19.52	0.06	2.36
1942–1943														
8	257	118.8	0.4	5.6	21.87	0.18	2.82	238	118.5	0.4	5.5	21.49	0.20	3.03
9	308	124.2	0.4	6.6	24.11	0.20	3.45	312	123.7	0.4	6.4	23.91	0.19	3.34
10	447	129.7	0.3	7.2	27.34	0.23	4.87	374	128.6	0.4	7.1	26.43	0.24	4.56
11	898	135.5	0.2	7.0	30.91	0.17	5.02	598	134.4	0.3	5.9	29.87	0.23	5.62
12	1,290	140.1	0.2	7.7	33.53	0.15	5.46	698	140.3	0.3	8.3	33.73	0.25	6.74
13	1,400	144.5	0.2	8.4	36.40	0.16	5.94	682	146.1	0.3	8.5	38.52	0.28	7.41
14	1,178	151.0	0.3	9.5	41.04	0.22	7.49	564	150.8	0.3	7.5	43.83	0.31	7.35
15	1,049	158.6	0.3	9.6	47.11	0.26	8.45	447	154.2	0.3	6.6	47.77	0.35	7.38
16	839	164.4	0.3	8.4	52.95	0.28	8.02	445	156.4	0.3	5.8	52.14	0.31	6.47
17	778	168.1	0.3	7.3	56.43	0.29	8.02	325	158.3	0.3	5.8	54.38	0.32	5.78
18	519	170.4	0.3	6.6	60.16	0.30	6.92	149	158.7	0.4	5.5	56.19	0.47	5.67
19	220	170.7	0.4	5.7	60.20	0.45	6.67							
20	107	171.7	0.6	6.0	62.50	0.56	5.76							
1945														
7	351	115.9	0.4	5.8	20.23	0.11	2.95	356	115.5	0.3	6.0	20.19	0.16	3.15
8	585	118.9	0.2	5.4	21.78	0.13	3.11	555	118.4	0.2	5.5	21.54	0.14	3.36
9	728	123.4	0.2	6.1	23.60	0.12	3.32	696	122.4	0.2	6.0	23.13	0.13	3.39
10	880	127.2	0.2	5.7	25.52	0.11	3.41	877	126.9	0.2	6.1	25.40	0.12	3.62
11	942	131.5	0.2	6.1	27.63	0.12	3.71	965	131.6	0.2	6.3	28.03	0.13	4.12
12	978	135.3	0.2	6.5	30.09	0.13	4.14	986	136.7	0.2	7.1	30.97	0.15	4.73
13	672	138.6	0.3	7.0	31.83	0.18	4.66	597	139.8	0.3	8.0	33.28	0.22	5.58
14	376	143.0	0.4	8.1	34.81	0.28	5.43	201	143.1	0.5	7.5	35.13	0.40	5.72

[1] Measurements at birth were made by Professor D. Antonopoulos in 1942 at the Athens Maternity Hospital. Data for ages 8 to 20 years in 1942–1943 are from measurements made by Dr. Papaioannou and the author. Data for 1944 and 1945 are from surveys made by a group at the Institute of Social Insurances in which the author participated.

period from 1942 to the spring of 1944 with average heights obtained in 1927-1928 indicates that Greek children were slightly taller than they had been fifteen years earlier. Comparison of the average weights shows that during these years of the occupation, the children were appreciably lighter than in the prewar period. This reduction in body weight was anticipated, of course, because of the famine and the consequent severe malnutrition of the child population. Measurements from the 1945 survey indicate that the continued undernutrition had affected growth as well as weight and the children were shorter and lighter than those of similar age measured two to two and a half years previously.

The differences between the mean heights and weights of children measured in 1927-1928 and in the later surveys are shown in Figure 5 for each year of age and indicate more clearly the "gain" or "loss" in height and weight of children in the war years. The increase in height at ages 1 and 2 years in 1944 is so great that it is doubtful that the measurements are comparable with those for 1927-1928 and height and weight changes shown in Figure 5 are for boys and girls aged 3 years and older.

The changes in heights and weights at specific ages as compared with the prewar mean values differ appreciably at different ages for both boys and girls, but several conclusions are suggested. In 1942-1943, some increase in height is shown for boys and girls at every age; for girls, the increase tends to be greater after age 11 years but for boys the increase declines consistently after age 11 years. Some increase in the average heights of children in years just preceding World War II has been reported from a number of countries and apparently this trend was characteristic also of Greek children. It is not possible to determine whether the famine years had retarded growth by 1942-1943 but the consistent decline in height increase for boys from age 11 to 17 years, normally a period of rapid growth, suggests that some retardation of growth had occurred. By 1945, retardation in growth is striking

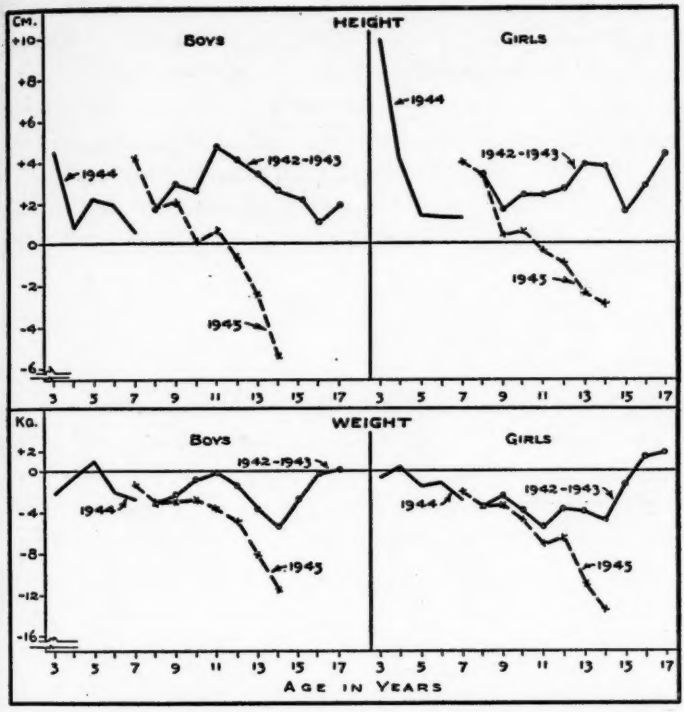

Fig. 5. Increase or decrease in mean heights and in mean weights of boys and girls measured during the war years from mean heights and mean weights obtained in 1927-1928.

for both boys and girls and increases at successively older ages from 10 to 14 years.

In spite of greater average height in 1942-1943 than in 1927-1928, the average weight was less at nearly every age under 16 years of age for both boys and girls. At most ages, girls show greater loss of weight than boys. In 1945, further loss of weight is indicated. This loss was greater proportionally than the decrease in height at corresponding ages, as is shown by comparing the weight-height ratios as follows: average kgs. of weight per

100 cms. of height for boys aged 14 years were 31, 27 and 24, and for girls were 33, 29 and 25 in the surveys made in 1927-1928, 1942-1943, and 1945, respectively. Thus, the condition of the children, especially those from 11 to 14 years of age, appears to have become progressively worse as a result of the prolonged malnutrition.

B. *"Pelidisi" Index.* The Pelidisi (Pondus decies lineare divisic sedentis altitudo) index of von Pirquet, which is supposed to express the nutritional status of an individual has the following form:

$$\text{Pelidisi} = \sqrt[3]{\frac{10.\,W}{S.\,H.}}$$

where W stands for weight and S.H. for sitting height.

Two sources of information on the above subject are available from Greece. The first refers to 55,764 children aged 1 to 17, examined during the spring of 1943 in the childrens' canteens of Athens, under the supervision of Dr. H. Korrodi of the Swiss Mis-

Table 7. Pelidisi index for Athenian children (both sexes) examined by Dr. H. Korrodi of the Swiss Mission in 1943.

Age in Years	No. of Children	Mean Index	Per Cent With Specified Pelidisi			
			Total	Less Than 96	96–100	101 or More
1– 2	577	100.6	100.0	14.9	35.7	49.4
3	3,067	100.2	100.0	19.9	34.6	45.5
4	4,097	99.1	100.0	22.5	40.9	36.6
5	4,429	98.1	100.0	30.1	39.8	30.1
6	4,841	96.1	100.0	47.2	34.7	18.1
7	5,282	95.8	100.0	50.4	35.1	14.5
8	5,804	95.3	100.0	55.2	33.1	11.7
9	5,205	95.1	100.0	56.3	33.7	10.0
10	5,684	95.0	100.0	57.0	33.2	9.8
11	4,567	95.0	100.0	57.6	32.2	10.2
12	5,252	95.0	100.0	56.9	33.7	9.4
13	3,937	95.2	100.0	55.6	34.2	10.2
14	2,385	95.5	100.0	53.3	33.8	12.9
15–17	637	97.0	100.0	39.9	39.8	20.3

sion in Greece. The analysis of these data was prepared by the writer. The second source comes from the same research made in 1944 by the Social Insurance group referred to above, on a total number of 11,231 boys and 11,020 girls aged 2 to 7 years. The number examined and the mean Pelidisi at each age for these studies are given in Tables 7 and 8 and the change in the mean values with age is shown in Figure 6.

In the 1943 survey, the Pelidisi index, which in the first 2 or 3 years of age stands at a normal level, rapidly drops after this age to reach the lowest point at the age of 10 to 12 years. The condition of older children looks somewhat better as most of these were accustomed at that time to go out for work or at least they were able to look after themselves during the critical months of the acute famine. Young babies up to 2 years of age were also

Table 8. Pelidisi index for Athenian boys and girls examined by the Social Insurance Group in 1944.

Age in Years	No. of Children	Mean Index and St. Error	Standard Deviation	Per Cent With Specified Pelidisi			
				Total	Less Than 96	96–100	101 or More
	BOYS						
2	1,422	98.7 ± 0.2	6.1	100.0	28.4	35.0	36.6
3	1,846	97.9 ± 0.1	5.4	100.0	34.3	36.9	28.8
4	2,274	97.1 ± 0.1	5.5	100.0	42.1	33.5	24.4
5	2,288	96.0 ± 0.1	5.3	100.0	51.0	31.3	17.7
6	2,193	94.8 ± 0.1	5.0	100.0	62.3	25.9	11.8
7	1,208	94.7 ± 0.2	5.7	100.0	64.7	24.1	11.2
	GIRLS						
2	1,255	99.3 ± 0.2	5.7	100.0	26.0	34.5	39.5
3	1,652	97.9 ± 0.1	5.4	100.0	34.4	36.2	29.4
4	2,185	97.3 ± 0.1	5.5	100.0	39.4	35.3	25.3
5	2,402	95.9 ± 0.1	5.0	100.0	49.5	34.9	15.6
6	2,252	94.9 ± 0.1	4.9	100.0	60.7	27.8	11.5
7	1,274	94.9 ± 0.2	5.6	100.0	62.2	24.9	12.9

well protected because of an adequate follow-up, and distribution of milk and other food. Those who suffered most were children over 7, and those who had not yet reached puberty. Very little extra food was given for these children who were too young to take any care of themselves during that wild period of frantic search for any kind of food to save life.

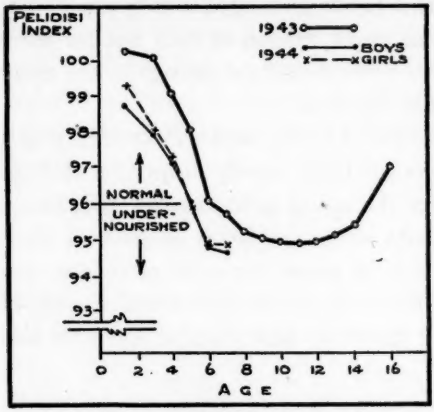

Fig. 6. The mean Pelidisi index at each year of age for children measured in 1943 and in 1944.

Data from the two surveys, the one made by Dr. Korrodi in 1943, and the other of the Social Insurance group, carried out one year later in 1944, run parallel and act as controls on each other. The only difference is that the mean Pelidisi from the second survey is lower, indicating that nutrition of the people was aggravated during the period which elapsed between the two surveys.

The same results are observed in Figure 7 which shows the percentages at each age in the three groups: undernourished (Pelidisi below 96), normals (Pelidisi 96 to 100), and overnourished (Pelidisi over 100).

The percentages of children found to be undernourished on the first survey increased from 15 per cent at ages 1-2 years to 55 per cent at age 8 years, and remained fairly constant to age 14. At ages 15 to 18 years, the per cent decreased to 40[8]. The worst period is found again to be between the ages of 7 and 14 years.

[8] *Editor's Note.* Variation with age in the percentage of children having a Pelidisi of 94

(Continued on page 233)

The normally fed children are about one-third of the total at all ages. Overfed children who in the first year are 40 per cent to 50 per cent of the total number, decrease in percentage quickly to about 10 per cent at ages 8 to 14 years, and increase slightly after 15 years of age.

In the second survey, in 1944, the percentages in the undernourished class at ages 2 to 7 years are consistently higher than for the same age in the 1943 survey. The per cents increase from 28 for boys and 26 for girls aged 2 years to 65 and 62 for boys and girls, respectively, aged 7 years.

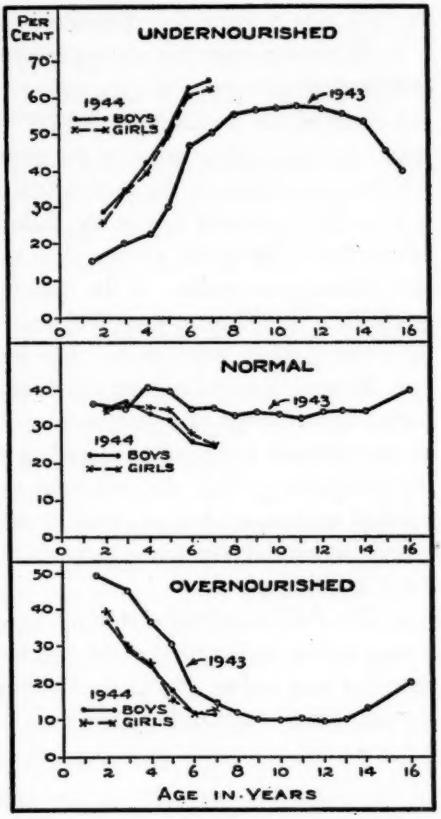

Fig. 7. Percentages of children examined in 1943 and in 1944 classified according to the Pelidisi index as undernourished (index below 96), normally fed (index 96-100), and overnourished (index 101 or more).

or less was reported by Clark, Sydenstricker, and Collins, who applied the Pelidisi standard to school children in the United States classified by physicians as in "good" or "excellent" nutrition. Age differences were as follows: 6-8 years, 26.6 per cent; 9-11 years, 21.7 per cent; 12-14 years, 12.7 per cent; and 15-18 years, 2.4 per cent. If this variation in the Pelidisi is applicable to Greek children, then the older children were actually more undernourished and not less so than the younger children. *Cf.* Clark, Taliaferro; Sydenstricker, Edgar; and Collins, Selwyn C.D.: Indices of Nutrition. *Public Health Reports*, 38, No. 23, June 8, 1923, pp. 1239-1270.

Summary

1. In two somatometric surveys made on children of the Athens area during 1942-1943 and 1944, and one survey in Piraeus in 1945, the effect of the previous famine (of 1941-1942) and the subsequent chronic malnutrition of the population is shown to have had marked effects on the population.

2. In the 1942-1943 survey, the children were somewhat taller but weighed less on the average than those of similar ages examined fifteen years earlier. In the 1945 survey, the average heights of children aged 8 to 14 years had decreased and at ages 12 to 14 years the children were shorter than in 1927-1928.

3. According to the Pelidisi index measured in a survey in 1943, babies up to the age of 3 years were almost normally fed because of the elaborate system of baby-feeding stations organized during the occupation period; children from 4 to 14 years of age showed marked undernourishment (over 50 per cent of those aged 7-14 years); older children (over 14 years of age) were in a slightly better condition.

4. The Pelidisi index for children aged 2 to 7 years obtained in a 1944 survey, indicated that the nutrition of children was worse than one year earlier. No marked difference is observed between the nutritional status of boys and girls.

WARTIME POPULATION CHANGES IN THE UNITED STATES

CONRAD TAEUBER[1]

WHILE fighting the costliest war in history, the United States increased its population more rapidly than in prewar years. There was no active program for promoting this population growth, and no basis in past experience for expecting it to occur.

The total population of the United States, including Armed Forces at home and abroad, increased at an average rate of nearly 1.2 per cent per year from 1940 to 1946, reaching more than 140 million. During that time the United States had increased its Armed Forces to a maximum of 12.3 million; five million of whom were overseas in the last year of the war. Some 300,000 members of the Armed Forces were killed as a result of enemy action. Nevertheless the rate of population growth in 1940-1946 was actually above that of the prewar years 1935-1939. Civilian health was essentially unimpaired and medical advances continued. Crude death rates for civilians had dropped 5.5 per cent below the prewar level by 1942, but had returned to nearly the prewar level by 1943. The maternal death rate had been cut in half by 1943, the infant mortality rate had dropped one-fourth, and the stillbirth rate one-fifth. Even though the numerical contributions of these improved mortality conditions were relatively slight, the declines of maternal and infant death rates in 1943 "saved" 37,000 babies and 7,000 mothers who would have died if 1935-1939 death rates had prevailed.

Declining civilian mortality and a net immigration of about 600,000 contributed to the population increases of the war period, but the fundamental factor responsible for the increase was in-

[1] Special Assistant to the Chief, Bureau of Agricultural Economics. This paper was presented before the Population Association of America, Princeton, New Jersey, June 1, 1946.

creasing fertility. The crude birth rate had increased 26 per cent above its 1935-1939 level by 1943. In 1945 it still remained nearly one-fifth above the prewar level. The number of births increased from an annual average of 2,434,000 during the five prewar years, to 3,127,000 in 1943, and in 1945 was still 2,905,000. The gross reproduction rate for native white women increased from 104.8 in 1935-1939 to 131 in 1943. In 1945 it was 120.[2]

If the extraordinary spurt in population increase in the war years reflects no fundamental shifts in the economy, the pattern of population distribution or the family values of the American people, the major demographic effect of the War will be the creation of a bulge rather than a gash in the age pyramid. It is not intended here to predict the future of the American economy as a basis for the prediction of the demographic future of the American population, which is essentially the future of the birth rate. But it is possible to assess the developments of the future on the basis of the fairly detailed statistics of the war period and the fragmentary data of the early postwar period.

The traditionally mobile American people were even more mobile during the war years. A sample enumeration in March 1945 indicated that some 15,000,000 civilians were living in a different county from the one in which they had resided at the time of Pearl Harbor.[3] Adding the number of persons in the Armed Forces brings the total to 27,000,000, or about one-fifth of the total population of the country.[4] People moved into and out of each of the major regions of the country, but there were net

[2] Whelpton, P. K.: The Effect of World War II on Fertility in the United States. Paper presented at the American Sociological Society, March, 1946.

[3] Civilian Migration in the United States, December 1941 to March 1945. Series P-S, No. 5. Bureau of the Census, United States Department of Commerce.

[4] It should be noted that the migration figure used does not represent the total number of people who moved at least once during that period, since it does not count the number of persons who had moved away from the county of residence at the time of Pearl Harbor and had returned by the time the Census enumeration was made, nor does it include those migrants who died, or those children who were born after Pearl Harbor and subsequently moved.

losses in the North and South and a net gain in the West. If the net results of the changes in residence for civilians are expressed as annual averages, the West gained about twice as many migrants as during the prewar period, and the South lost about five times as many. The annual losses in the North were about three-fourths as great as during the prewar period.

The regional figures give only minimum estimates of the further concentration of population as a result of the war migrations, for there was also a further concentration of population in metropolitan areas. Population estimates prepared on the basis of Ration Book Registrations in November 1943 indicated that the civilian population of 137 metropolitan areas, including about half the total population of the country, had increased by 2.2 per cent since 1940, whereas the civilian population of the remainder of the country had declined by 3.1 per cent.[5]

There were striking shifts in the farm population during the War. The disparate developments of the 'thirties, with rapid technological development reducing the labor needs in agriculture while the adult population on farms was increasing, resulted by 1940 in a farm population larger than that needed for agricultural production under efficient utilization. The rapid increase in the demand for workers outside agriculture first reached the more prosperous areas from which workers could most readily make the desired adjustments to urban industrial life, but these areas had insufficient population reserves to continue to meet the demands for workers. The less accessible areas were gradually tapped until at the end of 1943 the "population pressure" areas of the 'thirties had yielded large numbers of migrants. In some of these problem areas the losses were sufficient not only to cancel the gains of the 1930-1940 period, but even to reduce population below the level of 1920.

[5] Estimated Civilian Population of the United States, by Counties: November, 1943. Series P-44, No. 3. Bureau of the Census, United States Department of Commerce.

About eleven million persons moved from farms between 1940 and 1945, two million of them going directly into the Armed Forces. Four million persons moved to farms and the natural increase of the farm population amounted to two million. Hence the net result of the changes of the war period was a decline in the farm population from 30.3 million at the beginning of 1940 to 25.2 million at the beginning of 1945.[6] Nearly one-fourth of the farm residents who were 14 years old or over in 1940 and were still living in 1945 had left the farms by the latter date. Two-thirds of the young men who had been between 20 and 25 years of age in 1940 had migrated or entered the Armed Forces by 1945.[7]

The greatest reduction in the farm population occurred in the West South Central States which had contributed heavily to the farm-nonfarm migration of the 'thirties. In these States the farm population decreased by one-fourth between 1940 and 1945. The losses were least in the more industrialized States of the East North Central, New England, and Middle Atlantic groups, where they amounted to only about one-eighth. In these areas many farm residents accepted nonfarm employment but continued to live on farms.

Little information is available on the migration of Negroes during the War. Indications are that some areas of the South lost large numbers of their Negro population. However, for the nation as a whole, the percentage of migrants in the 1945 civilian population was about 12 per cent for both the white and the nonwhite populations. This figure in itself indicates an increase in Negro migration as compared to the prewar period, for in 1940 the proportion of migrants among whites was almost half again as great as that among nonwhites. The 1944 Censuses of Con-

[6] Farm Population Estimates, January 1, 1945. Bureau of Agricultural Economics, United States Department of Agriculture.

[7] Net Movement Away from Farms in the United States, by Age and Sex: 1940 to 1944. Series Census-BAE No. 4, United States Department of Commerce and United States Department of Agriculture, June 19, 1945.

gested Production Areas revealed that the nonwhite population increased more rapidly than the white population in the western and northern cities, where the numbers were small, and increased less rapidly in the southern cities of Charleston, Hampton Roads, and Mobile, where the numbers were large.[8]

Much of the wartime migration involved entire families, more so than during the prewar period, 1935-1939. In March 1945 the proportion of migrants among children under 14 was almost as great as that in the total population over age 14. Family groups were fairly mobile when children were young, less so when the children had reached adolescence. This age pattern of childhood migration is consistent with the fact that the proportion of migrants reached its peak in the group aged 25-29, declining regularly in the older age groups. The results of the Sample Censuses of Congested Production Areas, and the Registrations for War Ration Book Four in November 1943 also indicate a heavy incidence of family migration.

The migration from farms, like the other migrations, included a large proportion of families, though in some instances the family members followed some time after the breadwinner had made the first shift. The number of farm children under 14 decreased from 8.9 million in April 1940 to 7.7 million in April 1944. The reduction in the number of children was somewhat greater than the reduction in the number of all farm residents.

The crucial demographic question is that of the permanence of wartime shifts. Will most of the wartime migrants return to their previous residences, will they remain in their wartime locations, or will they move on to some other place? A large outmigration from some areas which received migrants during the War is inevitable, but if the expressed intentions of wartime migrants concerning their postwar plans, the postwar plans of

[8] Webb, John: Observations on the Sample Censuses in Ten Congested Production Areas. Washington, Committee for Congested Production Areas. December, 1944.

soldiers, the characteristics of the migration and of the migrants, and some scattered information on what has happened since VJ Day provide valid clues, there is little reason to suppose that any large proportion of the migrants will return to their former residences. So far as the farm population is concerned, there is no basis for expecting a large scale back-to-the-land movement. Experience during the War made it abundantly clear that the maintenance of a high level of agricultural production is not dependent on a return to 1940 farm employment levels. The problem of agricultural manpower today and for the immediate future is more one of distribution than of number of workers. Moreover, the areas which have contributed most to the volume of farm-nonfarm migration are generally areas with high rates of tenancy. Few of the migrants from such areas retain any rights to occupancy of the land, and, therefore, they have no place to which to return.

Studies in the San Diego, California, and Portland, Oregon, areas indicated that perhaps three-fourths of the wartime migrants were planning to remain after the War.[9] A survey of the post-war plans of soldiers indicated that there probably would be a heavy out-migration from the highly agricultural areas running from the West North Central States through the entire tier of Southern States. Another survey of white enlisted men in the Army found that nearly two-thirds of the men with farm experience who left farms to enter the Armed Forces planned to return to full-time farming, but that only 9 per cent of the young farm men who had entered some other occupation prior to their induction into the Armed Forces definitely planned to return to farming after the War.[10] Figures recently released by the Bureau

[9] After the War What? San Diego, Post War Planning Bureau, San Diego Chamber of Commerce, July, 1944.

[10] Post War Plans of the Soldier. Washington, D. C., Research Branch, Information and Education Division, Army Service Forces, War Department, 1945. *Also:* Soldiers' Plans for Farming after they Leave the Army. Report B-131. Washington, D. C., Research Branch, Information and Education Division, Army Service Forces, War Department, December, 1944.

of the Census indicate that as of April 1946 some 760,000 World War II veterans were working on farms. This number is equal to slightly more than one-half of all the farm workers who had entered the Armed Forces before the War ended.[11]

Estimates of the size of the farm population as of the end of 1945 indicate that no appreciable return movement of civilian migrants had yet occurred. During 1945 the farm population of the country increased by about 800,000 after a series of years with record-breaking decreases. However, most of the increase in the total farm population was due to an increase in the number of males 14 years of age and over during the year, and the bulk of that increase was due to the return of men from the Armed Forces.[12] A report on field observations in seventy-one counties throughout the country early in 1946 indicated that local informants did not expect most workers who had migrated to war industry to be available for hired farm work so long as any other work is available. They were willing to predict a sizable return of migrants only in the event of a severe and prolonged depression.[13]

If the patterns of migration during the War generally correspond to those existing before the War, there is some presumption that the population shifts may become permanent. To a very large extent the wartime movements were of such a character. From 1900-1940 the North exported a net total of about 1,800,000 persons to other sections of the country, and the South exported about 2,800,000 persons. In contrast, the West has gained about 4,700,000 persons through net in-migration. Between 1940 and 1945 the North exported a total of about 750,000 civilians, and the

[11] Ducoff, Louis J. and Hagood, Margaret Jarman: Veterans Returning to Farm Work. Washington, D. C., Bureau of Agricultural Economics, United States Department of Agriculture, May, 1946.

[12] Farm Population Changes: April, 1940 to January, 1946. Series Census-BAE No. 7. Washington, D. C., United States Department of Commerce and United States Department of Agriculture, May, 1946.

[13] Farm Population Adjustments Following the End of the War. Washington, D. C., Bureau of Agricultural Economics, United States Department of Agriculture, February, 1946.

South about 1.2 million; whereas the West gained about 2 million.

Shryock and Eldridge have compared the estimates of net interstate migrations for 1940-1945, 1935 to 1940, 1930 to 1940, and 1920 to 1930, along with State birth residence indexes (*i.e.*, net gain or loss through interstate migration of the native population) for 1940, 1930, and 1920.[14] The coefficient of correlation between the net migration by States for the 1935-1940 and 1940-1945 periods was 0.92. The correlations between the values for the wartime years and the earlier periods ranged between .71 and .87, all indicating a high degree of relationship between the net migration of the wartime period and that for earlier periods. Even if the influence of California, which has consistently had a high net in-migration, is eliminated, the relationships remain positive and significant.

Hauser secured similar results in his analysis of the migrations to large cities.[15] Largely in keeping with previous trends in internal migration, large numbers of migrants went to the cities of the West Coast, the Gulf Coast, the Great Lakes, and the South Atlantic Seaboard. The areas of out-migration were chiefly the West North Central and the Middle Atlantic States. For a considerable number of larger centers which experienced large in-migration, the population movements since 1940 have been chiefly a continuation of past trends. Conversely many of those losing population had a recent history of losses or of very slow gains.

There were exceptions, but in general the patterns of migration during the war years were not inconsistent with those of earlier periods. They represent an acceleration of the population shifts resulting from basic forces which have operated in population distribution during much of our recent history rather than exceptions that could easily be reversed when the war ended.

[14] Shryock, Henry S., Jr. and Eldridge, Hope T.: Paper presented at the meeting on Migration of the American Sociological Society, Cleveland, Ohio, March, 1946. (Unpublished.)

[15] Hauser, Philip M.: Wartime Population Changes and Post War Prospects. *Journal of Marketing*, January 1944, pp. 238-248.

The marked and probably permanent increase in urbanization and industrialization associated with the war period would tend in the long run to act as a strong depressant on the birth rate, other things being equal. This residential and occupational shift toward conditions favorable to the further decline of national fertility makes the question of the significance of the wartime increases in fertility particularly important. Has the downward trend of the birth rate been retarded, or was it simply interrupted by the coincidence of an abnormal stimulus to the establishment of families and a level of employment far above that of the decade of the 'thirties? The fact that the wartime increase follows an upward movement from a depression low makes it difficult to assess the factors involved in the war shifts.

The peak of births was reached in October 1942, ten months after Pearl Harbor. If allowances are made for seasonal variations, the decline began the next month and continued with minor irregularities to the spring of 1944; afterward there were only slight changes around an almost horizontal trend line.[16] The total number of births in 1945 was more than 7 per cent below the number for 1943. It is too early to state whether or not the expected postwar boom in births will materialize, although marriages increased contraseasonally during the last quarter of 1945 and continued at a high level early in 1946. The decline from the 1943 high may be interrupted in 1946, but that in itself is no reason for assuming a continuation of the relatively high levels of births reached during the war years.

It is easy to over-estimate the significance of the increases in fertility that have occurred in recent years. Whelpton has estimated that from two-fifths to three-fifths of the increase in birth rates during the war years would be eliminated if allowances were made for the post-depression increase of births which would probably have occurred even in the absence of war. Furthermore,

[16] Whelpton, P. K.: *Op. cit.*

although a birth rate of 22.9 per 1,000 population in 1943 (corrected for under-registration) may seem high at the present time, it is far below the rates that prevailed prior to World War I. In 1921, when the number of births was nearly equal to the number in 1943, the birth rate was 27.2. The birth rates of the war years, just as those of the depression, reflected the variations in a fertility subject to a high degree of control. That control, relaxed from the earlier period of depression and unemployment, could easily be intensified again if conditions become less favorable to the bearing and rearing of children.

Analysis of the fertility changes during the War indicates that the groups which had previously more effectively controlled their fertility, were the ones whose fertility increased most during the War. Whelpton reports that colored births were affected by the War to a lesser degree than white births. According to his computations, the average annual number of white births increased during World War II by 25.1 per cent, but the increase for colored births was only 20 per cent. If it is correct to assume that during the depression relatively larger numbers of white than of colored births were postponed, there were then larger deficits of white than of colored births to be made up during the high income years following 1939. Insofar as there was also some drawing on the future during the War, white births more frequently than colored births would reflect that phenomenon.

Farm women generally have had higher levels of fertility than nonfarm women, due in large part to differences in the extent to which fertility is controlled. Hitherto unpublished data supplied by the Bureau of the Census indicate that the ratio of children under 5 per 1,000 women 14-44 increased by 14.1 per cent between 1940 and 1945 for farm women compared with an increase of 28.7 per cent for nonfarm women. For both groups the level of fertility ratios in 1945 was greater than those for 1930. During the 1930 decade, the birth rate in the nonfarm population

appears to have decreased more rapidly than birth rates for the farm population and in the years since 1940 it appears to have increased more rapidly. These comparisons would be more conclusive if they could have been made on the basis of figures reflecting marital fertility. The very large migration of women in the reproductive ages from farms after 1940, may well have removed from the farm population more of those who were not married and those who had few or no children. It seems likely that if this factor could be taken into account, the differentials in the rates of increase between farm and nonfarm women would be greater than those reflected by these figures.

Analysis of trends in the numbers of births by age of mother and birth order permits a more precise evaluation of the dynamics of fertility during the war years, although only on a national level. Whelpton has summarized the trends in births by age of mothers as follows:

> Births to native white women 15-34 were rising gradually before the War and were affected but little by the European War phase. During U. S. preparation for the war, the rise was speeded up considerably; after Pearl Harbor there was a further substantial rise at ages 25-34. Births to women 35 and older were declining before the War, but the decline was checked during the European War period, and a substantial increase occurred during the U. S. preparation and U. S. war periods. Much of this increase probably represents births postponed because of the unemployment and low incomes which occurred during the depression.[17]

Statistics on the order of birth offer further evidence that the recent increases in birth rates may not represent continuing deviation from pre-existing trends. First births to native white women increased from an average of 740,000 during the five prewar years to a high of 1,095,000 in 1942, then declined somewhat in 1943. Their proportionate contribution to all births increased from 39

[17] Whelpton, P. K.: *Op. cit.*

per cent in the prewar years to 44 per cent in 1942, then declined again to 39 per cent in 1943. The number of second births continued to increase in 1943, when it reached a level of 60 per cent above that of the prewar years. This increase in second births was to some extent a consequence of the prior increases in the number of first births, for an increasing number of women were subject to the risk of having a second child. The increase in the number of first and second births combined over the prewar average was 543,000 in 1942 and again in 1943.

The number of third and fourth births also increased; in 1943, the former were 45 per cent, the latter 24 per cent, above their prewar levels. Fifth and higher order births continued to decline in the early war period, although there were some slight increases in the later war period. For sixth and higher order births the later increases were not sufficient to bring the number in 1943 back to the prewar average.

Whelpton concluded on the basis of a detailed analysis of the number of births by parity order to native white women by age cohorts that the substantial increase in fertility during the war years was due primarily to the occurrence of births postponed during the depression. World War II and its attendant economic conditions enabled the women born in 1905-1919 to have the first births that had been postponed by the depression, together with a relatively small number that would not have been expected on the basis of prewar trends. The experience of the cohorts of 1920 and later years was similar except that the surplus of actual over "expected" births was very small. The cumulative totals for first and second births to these cohorts were only approximately "normal" by the end of 1943. All cohorts of women had made up the deficits of first births below the "normals" established by Whelpton by the end of 1943 and even accumulated a small surplus. The larger deficits in second and higher order births had been reduced until they varied from a low of about 4 per

cent for second births to about 22 per cent for sixth and higher order births.

Whelpton's analysis offers evidence that the increase in fertility during the war years did not constitute a major alteration of long-time trends in this country. The precise relationship of wartime fertility to the expected "normal" may be altered somewhat when the experience of the future permits the computation of more satisfactory trend values for the period under review. Broadly speaking, however, his conclusions seem unlikely to be subject to serious challenge.

No numerical estimates of the future population or the future rate of natural increase will be presented here. Numerical projections of the postwar population of the United States into the future on assumptions that take into account the experience of the war years are now being prepared by the Bureau of the Census in consultation with Whelpton. It may be pertinent, however, to consider some of the factors growing out of recent developments that will have some relevance to the future trend of fertility and thus to the future rate of increase of the American people.

If the rural-urban migrations and the other population shifts of the war years are to a large extent irreversible, they are likely to result in somewhat lowered levels of fertility. Migrations from farm to nonfarm areas and from the South to the North and West, involve shifts from areas of higher to areas of lower fertility, and it is to be expected that women will tend to manifest the fertility patterns of the areas in which they are living rather than those of the areas in which they were reared.

The influence of the levels of employment and income on fertility patterns may become increasingly important in future years as the population becomes increasingly industrial and non-rural. Hauser's correlation between fertility and the legislative and administrative acts affecting the rate of induction into the Armed Forces, the rapid increase in marriage rates since VJ Day,

and the continued high correlation between marriages and first births suggest a direct influence of non-economic factors. But this was also a period of high levels of employment, lasting long enough to give many established families an opportunity to recover some of the losses of the depression years, and many new families an opportunity to have children and give them a level of care to which many had previously, and unsuccessfully, aspired.

The evidence now available is not sufficient to unravel the factors that were involved in the increase and later decline of fertility during the war years, but it does suggest that full employment may serve to maintain fertility above the levels established during periods of irregular employment. Should this nation succeed in providing continuing high levels of employment and security of income, the pattern of population growth in the future may differ from that projected on the basis of past experience. It is recognized that the lack of many desired consumption goods during the War may have reduced the competition between children and some major consumption goods, and that this may have resulted in higher fertility, either because of a reduction in the social pressures which ordinarily work toward a reduction in family size, or, in a few instances, because families rescheduled their larger expenditures, having children during recent years when high incomes made that relatively more easy and postponing heavy consumption expenditures until goods were more readily available. On the other hand, a reduction in fertility might have been anticipated on the basis of the large-scale employment of women, the crowded housing conditions in many industrial centers, the shifts of rural women to urban areas, the high rate of mobility required of many persons during the War, the separation of families because of military service or industrial migration, the disruption of many of the accustomed patterns of living and the increased exposure to knowledge of and increased access to contraceptive devices. These factors may have served

to restrain the increase in the birth rate below the level it would otherwise have reached. Perhaps the major implications of the recent experience for the evaluation of the immediate and the long run future is the possibility that full employment and its correlative of greater job and income security may result in some alteration of the pre-existing patterns of relationships between income levels and fertility. Projections based on "other conditions being equal" may need to be modified if other conditions are no longer equal to those which prevailed in the past.

Conditions affecting the birth rate in the future may differ from those in the past in still other respects than the level of employment. During the War this country became conscious of manpower and the implications of manpower for industrial development and military strength. More than ever before there was an awareness of the factors in population growth, a need for comparing the relevant facts for this and other countries, and a concern over the long range prospects for population growth. Countries which suffered many more casualties in both World Wars than we did are actively investigating the factors involved in population decline, and are establishing or intensifying pronatalist measures. The anticipated reduction of fertility from its wartime highs to more "normal" levels may touch off concern over population numbers in this country and thus create a more favorable climate for discussion and action in the field of population policy.

During the War this country experimented with some elements that probably would be found in any population policy which might be developed. The family allowances provided through the Armed Forces were direct payments to families to assist in providing for wives and children. The emergency maternity and infant care programs provided medical and hospital care to wives and infants of enlisted servicemen in the four lowest pay grades.

In addition to family allowances and the emergency maternity

and infant care programs there were other provisions operating to reduce somewhat the direct costs of maintaining children in the urban industrialized world. Provisions for nursery schools were developed in many areas, special feeding programs organized, school lunch programs maintained or expanded, and food distribution programs developed with the needs of children and pregnant and nursing women particularly in mind. Widespread attention was given to nutrition, particularly for the "vulnerable" groups. These activities did not constitute a population policy. They were expedients to solve problems incident to the conduct of the War, and in many cases they were dropped as soon as the immediate wartime urgency disappeared. It is not easy to assess their possible carryover. Perhaps the experience with them would arouse favorable responses from many persons should they be presented again under the auspices of a population program.

This discussion has not dealt with war casualties. Such losses are not to be minimized, but in the long run the wartime increases in fertility and the wartime population shifts are more significant than the wartime losses. There is no direct evidence that the War altered the long time downward trend in the fertility of the American population, although it may have arrested it somewhat and provided a period in which the abnormal losses of the depression years could be made up. Nonetheless, equal caution is called for in evaluating the supposition that in demographic matters there will soon be a return to prewar normalcy.

NUTRITIONAL STATUS OF AIRCRAFT WORKERS IN SOUTHERN CALIFORNIA

V. A CONSPECTUS OF THE SURVEY AND ITS FIELD[1]

HENRY BORSOOK[2] AND DOROTHY G. WIEHL[3]

THIS is the concluding paper on the Study of the Nutritional Status of Aircraft Workers in Southern California. It is a summary of the whole Study and discusses the results in the context of related studies and their objectives.

The immediate impetus to the undertaking of the Study came from the call for maximum production in the war effort. In the years preceding the National Emergency and the War the general public had become increasingly interested in nutrition, especially in the question of the value of vitamin supplements. A few employers were convinced that production was improved by improving the nutrition of their workers. In most cases this opinion was an interpretation of the results of tests, without controls, of supplementing the diets of workers with vitamin concentrates. There were no adequate studies of the nutritional status of the workers before and after a vitamin supplement was used, nor of precisely what was gained by its use.

In most industrial groups in the United States there is probably relatively little severe or acute nutritional deficiency. At the time of the declaration of the National Emergency in 1941 the effects of improving the diet of such a population on health, working ca-

[1] The Study of the nutrition of aircraft workers in California was sponsored by the Nutrition Committee (R. A. Millikan, Chairman), appointed by the Board of Supervisors of the County of Los Angeles, California, and the Committee on the Nutrition of Industrial Workers of the National Research Council. The Study was supported in part by the sponsors and by the following: the California Institute of Technology, The Lockheed Aircraft Corporation, the Milbank Memorial Fund, the War Production Board, and the Work Projects Administration (Project No. 12372). Support was also received from the California Fruit Growers Exchange, the Gelatin Products Corporation, Hoffman-LaRoche, Inc., Merck and Company, the National Oil Products Company, the Research Corporation, E. R. Squibb and Sons, and the Vita-Food Corporation.

[2] California Institute of Technology, Pasadena.

[3] Milbank Memorial Fund, New York.

pacity, and psychological state had not been demonstrated by adequately controlled studies. Such studies were desirable for purposes of war production, and also because of their bearing on a lively question before the War and since, epitomized as "optimal" versus "necessary" nutrition.

Accordingly the Committee on the Nutrition of Industrial Workers of the Food and Nutrition Board of the National Research Council recommended:

> that adequately controlled studies be conducted in war or defense industries to determine the facts concerning the influence of diet and nutrition on health, working capacity, incidence of accidents, absenteeism, and the psychological state. (1)

A study among workers at the Lockheed Aircraft Corporation, Burbank, California, was undertaken to meet this need. The Study began in November 1941 and ended in March 1943. Detailed accounts of the methods used and the results obtained are given in preceding reports (2, 3, 4, 5).

The Subjects of the Study

The Study began with 1,173 men who had volunteered to cooperate. They were divided at random into two groups; one received a vitamin supplement, the other a placebo.[4] Together the two groups comprised about 2 per cent of the total number of employes. The number of subjects who remained in the Study to the end was reduced to about half the initial number by terminations and transfers (4).

The subjects were largely young men, approximately 70 per cent of them being under 30 years of age at the beginning of the Study. The age distributions of those in the Placebo and Vitamin groups were very similar. Also, the duration of employment was

[4] The content of the supplement was as follows: vitamin A (from fish liver oil) 50,000 I.U.; vitamin D (from fish liver oil) 800 I.U.; thiamin, 10 mgs.; riboflavin, 10 mgs.; niacinamide, 100 mgs.; ascorbic acid, 250 mgs.; and calcium ($CaCO_3$), 500 mgs. For details on method of distribution, *see* earlier paper (4).

alike for the two groups. The average duration of employment for those who remained in the Study nine to twelve months was 12.6 and 14.1 months for the Placebo and Vitamin subjects, respectively. Initially, all subjects were on the swing shift; that is, they worked from 4:00 P.M. to 12:30 A.M., but slightly over one-fifth of them were transferred to other shifts during the Study year.

For the purpose of appraising the psychotherapeutic effect, toward the end of the Study year a second control group was formed of men who did not participate actively in the Study and did not know of their inclusion in it. From Company records, this group was matched with respect to age, duration of employment, and type of work with the direct production workers on the swing shift who had remained in the Study and on the swing shift to the end. This group was designated the Control group.

The subjects worked in many departments of the plant; often members of all three groups worked side by side. The three groups were, therefore, subject equally to the same environmental influences in the plant, and the different kinds of work done were represented equally in each group.

Criteria Used for the Appraisal of Industrial Performance

Data were obtained from official Company records on absenteeism, classified as Unauthorized, Illness, and Authorized; on terminations, classified as Military and Nonmilitary; and on work performance (from Merit Review scores).

Methods for the Appraisal of Nutritional and Physical Status

The diagnostic problem was the recognition of mild, or moderately advanced, chronic, nutritional deficiency disease. We anticipated that there would be few or no cases of severe deficiency disease. Accordingly the examination technique was designed to

detect both mild and severe forms of these diseases. As there were no methods of proved reliability for the diagnosis of mild nutritional deficiency states, one of the purposes of the Study was to test, by therapeutic trial, the validity of claims made in this connection for certain methods and signs.

The following is a general summary of the procedure adopted. At the beginning all the subjects were given a physical examination, certain hematological and chemical analyses of the blood were made, and diet and medical histories were taken. Toward the end of the Study year all the subjects remaining in the Study were reexamined, their blood analyzed, and their diet and medical histories taken again.

In the initial examination, the procedure consisted of:

1. Medical history.
2. Diet history.
3. Physical examination with special reference to evidence of nutritional disease.
4. Biomicroscopic examination of the conjunctiva for evidence of vitamin A deficiency, and of the cornea for evidence of riboflavin deficiency.
5. Examination of the blood for syphilis, hemoglobin, red cell volume, red cell count, serum albumin, and plasma ascorbic acid.

The final examination consisted of the above with the following changes: a more detailed record of skin conditions, especially of follicular hyperkeratosis of even the slightest degree; quantitative determination of thresholds of vibratory sensibility at different frequencies; a more quantitative record of corneal vascularity; biomicroscopic examination of the tongue; routine urinalysis. The serum protein determination was omitted.

Diet Histories

The diet histories obtained at the beginning and at the end of the Study showed that the diets of our subjects had remained

essentially unchanged (2, 4). The analysis of the diet histories of the initial examination (2), therefore, will serve for the diets of our subjects throughout the Study.[5] The quality of a diet may be appraised by a comparison with recommended standards of the consumption of protective food groups or of intake of specific nutritive essentials.

When the reported consumption of each of five food groups was compared with amounts recommended in the dietary pattern prepared by the Food and Nutrition Board of the National Research Council, the findings were:

(a) Percentages of diets for which the number of times used or amounts per week were equal to or slightly below that recommended:

	Per Cent
Green or yellow vegetables, 6 times or more	21
Citrus fruits or tomatoes, 7 times or more	36
Milk, 10 or more glasses	51
Eggs, 4 or more	59
Lean meat, fish, etc., 5 or more times	95

(b) Percentages of diets which were definitely below the recommended use per week:

	Per Cent
Green or yellow vegetables, 3 times or less—43 per cent	56
Less than 7 vegetables, with 5 or less green or yellow—13 per cent	
Citrus fruits or tomatoes, 4 times or less	49
Milk, 5 glasses or less	33
Eggs, 1 or none	23
Lean meat, etc., 2 or less times	1

When amounts of all five foods in an individual diet are considered: 2 per cent of the diets included amounts of each of the five foods as described in (a) above; 11 per cent had smaller amounts for one or more foods but none as low as described in

[5] There was a little improvement in foods containing ascorbic acid. This improvement was not great and did not change the diet picture significantly (4).

(b) above; and 87 per cent of the diets had amounts as low as described in (b) above for one or more food groups. The latter group of 87 per cent included: 32 per cent of diets low in one food group, 36 per cent low in two food groups, 16 per cent low in three food groups, and 3 per cent low in four food groups.

One-third of the group reported having eaten less than seven servings of vegetables (other than Irish potatoes) of any type, including tomatoes, during a week. Twenty-four per cent had eaten green or yellow vegetables less than three times within the week.

Nearly one-half of the men reported no servings of tomatoes or tomato juice during an entire week, and about 30 per cent had had one serving. Although tomatoes are a moderately good source of vitamin A, they are generally more important as a substitute for citrus fruits to furnish vitamin C. The consumption of citrus fruits was also low and surprisingly so in a California group. About 23 per cent had had none during an entire week, and 17 per cent had had only one or two servings. Only 36 per cent reported seven or more servings of citrus fruit or tomatoes during the week. The blood ascorbic acid levels (3, 5) were in accord with this feature of the diet histories.

The consumption of milk was better. Eleven per cent had had a quart or more per day, and 37 per cent two or more glasses daily. Another 24 per cent averaged one but less than two glasses daily, only 37 per cent had less than one glass per day. Eleven per cent drank no milk and used none on cereals in an entire week.

Eggs were not eaten regularly. Thirty-six per cent averaged one or more a day, 46 per cent less than one a day, and 18 per cent had none.

Only 5 per cent had meat less than five times a week, and four-fifths had meat seven or more times. Liver and other glandular products were reported by 22 per cent, 15 per cent had had one serving during the week; and 5 per cent two servings.

One-third of the men ate no whole wheat, rye, or "dark" bread during a week.

Judged by recommended dietary patterns, the diet of the group considered as a whole was low in yellow or green vegetables, citrus fruits or tomatoes, somewhat better in milk and possibly eggs, and adequate in meat.

This diet would be expected to be low in vitamin A, thiamin, riboflavin, ascorbic acid, and calcium. This was borne out by quantitative estimates (made from tables) of each of the following specific nutrients in two-day diets: protein, iron, calcium, vitamin A, thiamin, riboflavin, niacin, and vitamin C.

The percentages of all diets furnishing less than two-thirds of the Recommended Daily Allowance of specific nutrients were: ascorbic acid, 46.0; riboflavin, 43.2; calcium, 24.8; thiamin, 14.0; vitamin A, 14.8; niacin, 7.2; iron, 4.0; and protein, 0.8.[6]

Many men were eating low-calorie diets. 8.8 per cent were estimated as getting less than 1,800 calories daily, 17.6 per cent 1,800-2,199 calories, and 20 per cent 2,200-2,599 calories. Stated in other terms, only about one-fourth the men reported eating amounts of food which furnished 180 per cent or more of their estimated basal requirement, an amount adequate for men doing eight hours a day of moderately active work. For another 36 per cent of the men, the caloric intake was from 140 to 179 per cent of their basal requirement. Nearly 40 per cent reported diets which would furnish less than 140 per cent of their basal needs; and 5 per cent reported eating less than their basal needs.

As the quantity of food eaten was reported from memory, no doubt some of the men ate more than they reported, it is unlikely that any men ate less than their basal needs. But making considerable allowance for omission of some food items or under-

[6] These figures are based on the original values of the Recommended Daily Allowances. The only figures which would be significantly changed by using the Modified Allowances would be those for thiamin and riboflavin. They would be reduced to 8 and 22 per cent respectively.

estimates of quantity, the evidence is strong that many men were eating quite low-calorie diets. Other studies have reported dietaries which provided less energy than is usually recommended (10, 11, 12).

Estimates of caloric requirements now in use were made at a time when diets generally were inferior to those today, less fresh fruit and green or yellow vegetables were eaten and less milk was drunk, more physical work was done, the caloric intake was higher. The basal metabolic rate is influenced by the habitual caloric and protein intake (13). There is a need of redetermination of energy requirements.

The diets of most of our subjects could have been raised to the standards of "good" or "excellent" without any radical change in pattern. An increase in citrus fruits or tomatoes, and green vegetables, and a moderate increase in milk consumption—an additional glass a day for about one-fourth and an additional two glasses a day for one-third—would have been sufficient for this purpose. A small, but significant, proportion of the men ate a very restricted diet, and too little of it; they needed a generally increased consumption as well as better food choices.

It is a commentary on the difficulty of mass nutritional education of adults that the quality of the diets did not improve during the year of the Study, although there had been during this year intensive national and local nutrition campaigns which stressed the food groups of which most of our subjects ate too little. There was some improvement in the major deficiency, in the consumption of foods containing ascorbic acid.

Although most of the diets needed improvement, very few were so poor as to evoke clinical signs of severe nutritional deficiency disease. If they had been it is unlikely that the men could have held their places in the aircraft industry at the time the Study began, which was before December 1941.

Our Study group was, therefore, well suited for the therapeutic

test of methods and signs proposed for the diagnosis of mild, chronic nutritional deficiency states. The provision of a supplement containing large doses of a number of vitamins five days a week for nine to twelve months, it would seem, was a fair therapeutic test.

Results Obtained

1. *Industrial Morale and Work Performance* (4). At the beginning of the Study the Placebo and Vitamin groups were closely similar with respect to rates of absenteeism and of turnover (Non-military terminations) and in Merit Review scores.[7] Furthermore, for the first six months of the Study, absenteeism rates for the two groups did not differ significantly for any of the three classes of absences, that is, absences due to Illness, Authorized and Unauthorized absences.

In the last six months, the total absenteeism rate of the Placebo group was 4.79 days per 100 working days, and of the Vitamin group, 3.90 days. The difference is statistically significant and represents a reduction in absenteeism of 18.6 per cent. For each class of absences, the Placebo rate was higher, but the absolute difference between the groups was greatest for Unauthorized absences, and this difference accounted for 45 per cent of the total difference. The absenteeism rate for Authorized absences for the Vitamin group was one-third less than for the Placebo group, that for Unauthorized absences was 23 per cent lower, and that for Illness absences was only 9.5 per cent lower than for the Placebo group. The absenteeism rates due to Illness, 2.19 and 1.98 days per 100 days for the Placebo and Vitamin groups, respectively, were not significantly different; rates for both Authorized and

[7] Merit Reviews were made, by contract between the Company and the Union, of every employe by his immediate superior every six months. The review score given was an important factor in the decision whether or not an employe was given a raise in pay and how much. The scores used in the Study were from reviews made routinely; the reviewers had no knowledge, in most cases, of which men were participating in the Study, and, of course, were completely unaware that the subjects were divided into Placebo, Vitamin, and nonparticipating Control groups.

Unauthorized absences were very significantly lower for the Vitamin group.

Nonmilitary terminations in the last eight months of the Study were 13.5 and 8.4 per 100 employes in the Placebo and Vitamin groups. This difference is of borderline significance, the chances of its occurrence as the result of random influences being between 5 and 6 in 100.

In the Merit Review, each employe was scored by his immediate superior on six characteristics; namely, quality of work, quantity of work, adaptability, knowledge of his job, dependability, and attitude. The scores given for each characteristic range from 1 to 8. The Merit Review ratings made for the Company in the last few months of the Study were higher, on the average, for every characteristic for the Vitamin group than for the Placebo group, although the difference had been very small and not consistent at the beginning of the Study for the same employes. The average Merit Review scores at the end of the Study were 6.22 and 6.38 for the Placebo and Vitamin subjects. This difference of 0.18 is very small but is very significant statistically.

Taken together, these findings of less absenteeism from causes other than Illness, lower turnover rates, and higher Merit Review ratings for the Vitamin group seem to indicate that superior industrial morale was the major factor underlying the superiority in all three respects of the Vitamin group in the later months of the Study year.

Two of the three types of evidence which indicated a therapeutic effect of the vitamin supplement on industrial morale are drawn from objective data depicting behavior, *i.e.*, absenteeism and turnover. The third piece of evidence, the Merit Review scores, while not objective, may not be discounted entirely. Those who made the scores received explicit and detailed instructions to ensure a uniform standard of grading. The score given was a serious matter to both management and the worker as it directly

affected wages. All three pieces of evidence are remarkably in accord.

Comparisons of the nonparticipating Control group with the Placebo group indicated a positive psychotherapeutic effect on Unauthorized absences, which was short-lived and became ineffective after the first six months, and a positive effect on Illness absences which persisted throughout the Study year. There was no psychotherapeutic effect on Merit Review scores, the ratings being almost identical for the Placebo and nonparticipating Control groups.

As the same psychotherapeutic influences operated equally in the Placebo and Vitamin groups, it was, therefore, cancelled out in comparisons made between them. The only known difference in the factors operating on the two groups was the possible therapeutic effect of the vitamin supplement. On the evidence, there appears no reasonable alternative but to ascribe the greater improvement in morale in the Vitamin group to this therapeutic effect.

The consistency of the trend toward superior performance in the Vitamin group as the Study year progressed is the most persuasive feature of the evidence for crediting benefit to the therapeutic effect of the vitamin supplement. This consistency runs through all the causes given for absence, the data on turnover, and all six individual items in the Merit Review scores; it is seen in the comparison of the total populations of the Placebo and Vitamin groups and in the comparisons of subgroups matched for working shift.[8]

The rates of absenteeism and of turnover of both the Vitamin

[8] Data were collected on the number of visits to the first aid stations, as a measure of accident rate, and on tardiness. These data were so inconsistent internally, as to cast doubt on their reliability, and to warrant their exclusion. Inspection of the manner in which these reports were made and the reasons for which men visited the first aid stations found additional evidence that the recorded reports on tardiness and visits to the first aid stations were neither fairly nor consistently representative of events. The inclusion of these data would not have invalidated the more reliable data, nor have affected the specific or general conclusions deductible from the latter.

and Placebo groups were lower throughout the Study year than in the aircraft industry as a whole in southern California (4), indicating that the industrial morale of the Study group as a whole was superior to the average in the industry. In addition, as the subjects were volunteers for the Study, they may be presumed to be men who were consciously desirous of improving their health, with initiative (they acted on an opportunity to do something about it), and of a cooperative frame of mind. These traits are not present in all workers, and in those who possess them, they make for better industrial morale. The initial superiority to the average of the Study group in industrial morale obviously reduced the degree of improvement in this respect which the vitamin supplement or any practicable welfare measure could achieve.

There is, in addition, a general consideration to be taken into account in appraising the effects of any single welfare measure, namely, the multiplicity of factors which affect absenteeism, turnover, and work performance. Even among those which are known, some of the most important factors are beyond the control or even influence of either employer or employe. Those responsible for personnel relations in industry therefore do not demand a very great improvement from any single ameliorating factor, even from those as persuasive and direct as pay increases, introduction of rest periods, and improved eating facilities. What is hoped for is a worthwhile over-all result from the accumulated small effects of many factors in a welfare program.

Only a small effect can be expected from a factor operating as indirectly as the giving of vitamins, as was done in this Study, to a relatively superior group, neither severely malnourished nor undernourished, especially as, for the great majority, the work was not heavy and there were no hazards such as high temperature, very high or low humidity, or exposure to toxic chemicals.

Furthermore, this Study was conducted during the first year that the United States was in the War, and awareness of the

need for aircraft production no doubt was a strong incentive to many workers to stay on their jobs unless illness of a relatively serious nature prevented them from working. Under such conditions, any improvement in the work performance of young men which may result from taking vitamins is likely to be small. It should be borne in mind when appraising the effect of the vitamin supplement on absenteeism, turnover, and Merit ratings that, in order to obtain a measurable effect, any benefits must have been converted into spontaneous action on the part of some members of the group and that this action must have differed to a measurable extent from that of persons not receiving the vitamins.

As the vitamin supplement apparently had a beneficial effect on a group such as the above, and at a time when other incentives tended to obscure or minimize so indirect an aid as the giving of a vitamin supplement, one may reasonably expect similar or larger benefits in the general industrial population, especially where the work is strenuous and the vitamin B complex and C requirements are accordingly greater, and where the prevailing diet is less adequate than it was in our Study group.

Reduction in absenteeism and turnover and improvement in general work performance are important in themselves, whatever the explanation of the mechanism by which they were effected by the vitamin supplement. But elucidation of the mechanism is important. As stated above, all the evidence is in accord that the benefits noted were manifestations of improved industrial morale. From this point on we can only speculate. It seems a reasonable guess that improved industrial morale was associated with an improved feeling of general well-being. This claim is often made by users and advocates of vitamin supplements. It has been discredited because the evidence is not objective and the "experiments" were not adequately controlled. The following studies bear indirectly on this question.

It is well known that pathological mental symptoms occur in severe thiamin deficiency, in pellagra, and other conditions associated with severe vitamin B complex deficiency, and it is established that these symptoms are often relieved by adequate, specific therapy. The question is whether such symptoms exist in attenuated and modified form when the diet is not so deficient as to produce severe acute deficiency diseases, and extending it further, whether a vitamin supplement to a "normal" diet may effect psychological improvement above the "normal."

The Medical Survey of Nutrition in Newfoundland (6) estimated that the most serious dietary inadequacies were of calcium, and vitamins A, B_1, and B_2; the average available supply of these nutrients was 415 mg., 1,443 I.U., 0.90 mg. and 1.03 mg. respectively. These levels are above those at which clinical signs of severe deficiency disease commonly occur; cases of the severe acute deficiency diseases were not reported, although signs of less severe deficiency were very prevalent. The Survey characterized the people living on this diet as slow in mental reactions and lacking in initiative. The children were apathetic and subdued; they played little indoors or out. The subjects of all ages seemed older than their years.

In a placebo-controlled study of the effect of a poly-vitamin supplement on British school children, the teachers reported that a higher proportion of those who received the vitamins had improved behavior, the report from the parents was similar, but in both the teachers' and parents' records there was a high proportion of children who had apparently been improved by the control pellets (7).

Simonson *et al* (8) carried out a placebo-controlled study on the effect of a vitamin supplement on flicker fusion by "normal, healthy" adults. The daily vitamin supplement contained 6.0 mg. B_1, 8.0 mg. B_2, 80 mg. niacinamide, 0.24-0.32 mg. B_6, and 80-120 Jukes-Lepkovsky units of filtrate factors. Twelve subjects re-

ceived the vitamin supplement and eleven the placebo. Flicker fusion was improved in eight of the twelve vitamin subjects and in one of the eleven controls. One of the vitamin subjects could not maintain his improvement when the vitamin content of the supplement was halved. The subjects with improved flicker-fusion reported improvement in mental alertness and in the feeling of general well-being.

Simonson *et al* measured on the same subjects the effect of the vitamin supplement on working capacity and endurance in five different forms of physical work. No effect was found, which was the result found by Keys and Henschel (9). Keys and Henschel drew the general conclusion that a vitamin B complex supplement to a good diet was an ineffective aid against fatigue or for the performance of muscular work. Simonson *et al* commented on this conclusion:

> Working capacity and endurance depend on different functions in different types of work. Only one type was investigated by Keys and Henschel. . . . Functions of the central nervous system, which appear to be influenced by vitamin B complex, were not investigated.

The findings of Frankau (65) (*see* below) support Simonson's criticism of the drawing of final conclusions in this field from the results of one type of test.

There is a suggestive relationship between our findings that the vitamin supplement appeared to have improved industrial morale and the findings of Simonson *et al* that their vitamin B complex supplement appeared to have improved the function of the central nervous system, and that with this improvement there was a concomitant improvement in the feelings of mental alertness and of general well-being.

The experiment of Simonson *et al* resembled our Study in the type of subject, the quality of the diet, and the supplement used. They differed in, among other conditions, that our Study was carried on for a longer time; we employed no test of central nerv-

ous system function nor of resistance to fatigue; Simonson *et al* measured a physiological function while industrial morale is a psychological function.

Simonson's experiment is the first placebo-controlled study, as far as we are aware, in the important border region of physiological-psychological phenomena, in which a positive result was obtained by objective measurements on healthy adults in the relatively short period of a few months, by enrichment of a diet which was better than the minimum "necessary" for the prevention of deficiency disease. If the results are confirmed, they will indicate a fruitful direction for future investigation.

2. *Evidences of Vitamin A Deficiency* (5). Evidences of vitamin A deficiency were sought in (a) conjunctival opacity, thickening, and elevations, and in (b) the frequency of follicular hyperkeratosis. The reasons for this choice are discussed in previous reports (3, 5).

A biomicroscopic examination of the conjunctiva was made at both the initial and final examinations; the observers and rating criteria were the same on both occasions. The Study afforded, therefore, a therapeutic test of the conclusions of Kruse that conjunctival opacity, thickening, and elevations in adults are reversible signs of mild, chronic vitamin A deficiency.

At the first examination all the subjects had some degree of conjunctival opacity or thickening; 80 per cent had one or more elevated spots on the conjunctiva, most of them in the horizontal meridian near the cornea. At the end of the Study year there was no difference between the Placebo and Vitamin groups in the number of conjunctival elevations. In subjects of both groups there were differences between the findings recorded at their initial and final examinations, but these differences were slight, on the whole, and the frequency of increases and decreases was practically the same in both groups.

The results of the therapeutic test on conjunctival opacity and

thickening (other than spots) were evaluated by numerical rating of the condition observed at the beginning and again at the end of the Study in fourteen small subdivisions of the bulbar conjunctiva of each eye. The changes in rating at the two examinations were not consistent in any one individual for all parts of the conjunctiva in subjects in either group, and there was some improvement in subjects in both groups. On the basis of an arbitrary amount of improvement representing fairly extensive thinning of the conjunctiva, 23 per cent of the Vitamin subjects and 13 per cent of the Placebo subjects showed this maximum change and the difference is very significant statistically. The average ratings of the Vitamin and of the Placebo groups as a whole showed slightly less opacity and thickening at the end of the Study year in the Vitamin than in the Placebo group.

A fair summary of the therapeutic test is that administration of 50,000 I.U. of vitamin A five days a week for nine to twelve months did not produce in most of the recipients a large or unmistakable improvement, there appears to have been a small positive effect in some subjects. The result in the group as a whole was not definitely positive, but it may be considered as suggestive.

It is possible, and our Study affords no information on the question, that a more prolonged period of therapy or larger doses than were given in this Study may effect more complete reversal of conjunctival thickening and opacity than we observed. Another related question on which our Study provides no data is whether or not any level of vitamin A intake maintained all through life will prevent or retard the development of conjunctival opacity and thickening. The question resolves itself into whether or not the pre-xerotic condition described by Pillat and others (5) which has been proved to be associated with vitamin A deficiency and which responds to vitamin A therapy is etiologically related to the similar appearing, very frequent, conjunctival condition in a population such as ours. Is the latter condition

the result of a more chronic, milder vitamin A deficiency requiring more prolonged and massive therapy to reverse it than the former?

A high prevalence of mild follicular hyperkeratosis was found at the second examination, less in the Vitamin than in the Placebo group; rates were 68 and 83 per cent, respectively. A severe form of this condition has been proved to be associated with a vitamin A deficiency in man and in the rat. The condition is reversible, *i.e.,* it disappears nearly completely with adequate vitamin A therapy (5). In our cases it was milder than in the cases described by Frazier and Hu and others. Its frequency, severity, and the extent of skin involved were less at the final examination in the Vitamin than in the Placebo group.

At the first examination only the severe form of follicular hyperkeratosis was noted (very few such cases were found), while on the second examination even the mildest degree was recorded. The data of the two examinations, therefore, are not comparable, and it is not permissible to conclude that the less frequent and milder follicular hyperkeratosis found in the Vitamin than in the Placebo group at the second examination represented a therapeutic effect of the vitamin supplement.

There is reason to believe, however, that this difference between the two groups may have been a therapeutic result. At the beginning of the Study the two groups were practically the same in every respect in which they were compared. If one assumes that they were probably the same at that time with respect to follicular hyperkeratosis, then the difference in the two groups at the end of the Study in favor of the Vitamin group would represent a therapeutic effect of the vitamin supplement. But a firm conclusion cannot be drawn so long as it rests on such an assumption, it must be classified only as a suggestion which warrants an adequately controlled therapeutic trial.

There is another reason for caution. The prevalence of mild

follicular hyperkeratosis at the end of the Study year was quite high in the Vitamin as well as in the Placebo group. Would more prolonged therapy clear these cases, or, are there both reversible and irreversible forms of mild follicular hyperkeratosis? If there are, is their etiology the same, or is it different? The Study leaves these questions open.

3. *Evidences of Thiamin Deficiency* (5). The first examination found a considerable number of our subjects with conditions frequently associated with proved thiamin deficiency. A relatively small number had absent ankle and knee jerks. Calf muscle tenderness and plantar dysesthesia were found in 15 per cent of subjects, and impaired vibratory sensibility in over 25 per cent. Other studies have reported similar findings.

The Study provided a therapeutic test of whether these neurologic changes can be reversed in a year by a supplement containing large doses of thiamin and other vitamins.

The results of the test were negative.[9] All of the data, including measurement of thresholds of sensibility to different frequencies of vibration were consistent in showing no significant differences between the Vitamin and Placebo groups at the end of the Study year.

Impaired vibratory sensibility and paresthesias evoked by vibratory stimulation were significantly more frequent in the older than in the younger age groups. As these signs of impaired neurologic function occur in an otherwise healthy population, they appear to warrant classification as "pre-senile" changes.

[9] For conditions which occur infrequently in the population, the difference between two rates must be relatively larger in order to be statistically significant than in the case of conditions which are fairly prevalent. For example, one or both ankle jerks were absent in 10.0 per cent and 8.1 per cent of the Placebo and Vitamin subjects, respectively, and although the latter rate is 19 per cent lower than the former, a difference of this amount may be expected to occur from chance in 40 to 50 out of 100 trials for groups of about 260 persons. The rate for the Vitamin group must be less than 5.0 per cent, or a reduction of 50 per cent as compared with the Placebo rate, in order to show a statistically significant difference. On the other hand, the prevalence of follicular hyperkeratosis was 68 per cent among Vitamin subjects compared with 83 per cent among Placebo subjects, or 18 per cent less frequent, and the difference would be expected to occur from chance less than once in 1,000 times.

Yet it is anomalous that the same signs disappear with adequate therapy in proved cases of thiamin deficiency and not in a group of "normal" subjects. To classify these signs in the latter group as "pre-senile," *i.e.*, as signs of an irreversible condition, when they are demonstrably not so in a group whose reparative processes might be expected to be less effective, seems premature.

There are a number of possible explanations of the anomaly: we might have found a different result if the vitamins had been given parenterally instead of orally, or if our supplement had included other members of the vitamin B complex and such therapeutically allied substances as are contained in liver extracts, or a mild deficiency of long duration may lead to greater irreparable damage than a severe deficiency of short duration.

The high incidence of neuropathology in "normal" young people calls for thorough study. And judgment on its etiology, cure, and prevention may well be suspended at present.

4. *Evidence of Riboflavin Deficiency: Corneal Vascularity* (5). Since the publication by Kruse *et al* that vascularization of the cornea is an early and specific sign of riboflavin deficiency, it has been the subject of much investigation and discussion (5).

As practically all our subjects had some degree of corneal vascularity at the first examination, and over 40 per cent had "streamer" type vessels extending beyond the limbus into the cornea, the group was well suited for a therapeutic test of corneal vascularity as a reversible sign of riboflavin deficiency.

The results of this test, as in most other studies of the question, were negative.

5. *Evidence of Vitamin B Complex Deficiency* (5). The evidence sought was in the face and skin—seborrheic and pellagrous dermatitis and angular stomatitis; in the lips—cheilosis; and in the tongue—abnormal coloration, hypertrophy or atrophy, and abnormalities of the papillae (by biomicroscopic examination).

Most of these are signs of severe deficiency states; few cases with

signs of severe deficiency were found either at the first or second examination. This was to be expected in subjects such as ours. On the second examination, when milder degrees of the above abnormalities were noted, 17.2 and 7.3 per cent of the Placebo and Vitamin subjects, respectively, were found with two or more signs on the tongue associated with niacin or vitamin B complex deficiency.[10] The conditions found are presumably referable to chronic, mild deficiency states. Our findings suggest a possible therapeutic effect of the vitamin supplement, they afford no proof as there were no comparable data from the initial examination. The situation is the same as in the prevalence of follicular hyperkeratosis. The findings in both instances are in accord with those of other studies which were adequately controlled.

6. *Results of Laboratory Tests* (5). On the first examination many subjects had low plasma ascorbic acid levels, in 32 per cent they were below 0.40 mg. per cent and in 10.7 per cent below 0.20 mg. per cent. As the vitamin supplement supplied 250 mg. ascorbic acid daily the Vitamin group levels at the second examination were high; nearly all were above 0.90 mg. per cent. The Placebo group levels were a little higher than at the first examination, in only 17.7 per cent were they below 0.40 mg. per cent and in 2.6 per cent below 0.20 mg. per cent.

We were not in a position to obtain any evidence of the effect of the ascorbic acid supplement on gum conditions which have been interpreted by some workers as prescorbutic signs, *i.e.*, as indicating mild to moderate, acute or chronic vitamin C deficiency.

The hematological picture was not improved by the vitamin supplement, even in the cases of anemia, most of which was mild. There were no cases of severe anemia.

[10] A lower prevalence of seborrhea and sebaceous plugs on the nasolabial folds (a condition attributed to riboflavin deficiency) in the Vitamin group than in the Placebo group was suggestive of a possible therapeutic effect, but the difference in rates, 8.4 and 12.0 per cent, respectively, was not statistically significant. A difference as great as this may be expected to occur as a result of random sampling once in five to six times, *see* footnote 9.

There were no notable findings in the routine urinalyses of either the Placebo or Vitamin groups.

7. *Effects of the Vitamin Supplement and of the Placebo on Symptoms.* In the medical histories of the first examination about 80 per cent of the subjects reported having had one or more colds recently; more than half had symptoms of eye discomfort, or of gastro-intestinal malfunction; and between 10 and 25 per cent reported cramps, burning, or pins and needles in the feet, and of being easily irritated. When the data of the second medical history were compared with those of the first no evidence was found of any consistent beneficial effect of the vitamin supplement on the incidence or severity of upper respiratory infections, including colds, nor of improvement in symptoms. Nor was consistent evidence found of a beneficial psychotherapeutic effect.

The reports in the two medical histories were often inconsistent with the replies when the subjects were asked, "Did you get any benefit from the pills?" and when the answer was "yes," "what benefit?" Over 70 per cent of the subjects in the Placebo as well as in the Vitamin group reported a number of symptomatic benefits which they ascribed to the tablets and capsules they had been taking. The benefits they most frequently reported in answer to these questions were fewer or less severe colds, improved appetite, a feeling of better general well-being, and improvement in eye symptoms. There were slightly more such reports from the Vitamin than from the Placebo subjects.

Interpretation of the Clinical Results

In an appraisal of the clinical value of vitamin supplements such as were used in this Study, and based on our results, certain characteristics of our subjects should be taken into account. Over 70 per cent were under 30 years of age at the beginning of the Study. They had passed preemployment medical and psychological aptitude examinations, and their health and their psycho-

logical aptitude were important points in their selection for employment. The factor of selection was real because, at the time these men sought employment, the labor supply exceeded the demand.

No acute or severe nutritional deficiency diseases were found at the beginning nor at the end of the Study. This was to be expected in a group so selected, which was relatively well paid, on steady employment, and living in a section of the country where the quality of the diet was, on the whole, superior to that in any other part of the country (16). Consequently there was no opportunity for dietary improvement, by vitamin supplements or other means, to effect dramatic improvement in health, which undoubtedly would have occurred had there been a relatively high prevalence of severe or acute nutritional deficiency diseases.

These characteristics of our subjects are doubtless responsible, in part, for the slightness of the improvement of clinical signs in the recipients of the vitamin supplement. One of the objectives of the Study was to ascertain in precisely such a population as the subjects of the Study the degree, if any, of mild, chronic nutritional deficiency. The proof of the existence of such states and their diagnosis are two aspects of the same question. This was, and still is, an unsettled question, and the slight, inconclusive, though suggestive results obtained in the Study may aggravate the controversy. It seems worthwhile, therefore, to place in juxtaposition interpretations of the clinical results of the Study from the two opposed points of view, and to indicate the qualifications necessary to a fair summary of the findings and their implications.

The interpretation from one point of view is that the vitamin supplement contained therapeutic, *i.e.,* large doses, of vitamin A, thiamin, riboflavin, niacin, and ascorbic acid. It was administered for a long period, *i.e.,* five days a week for nine to twelve months, long enough to expect a definite therapeutic response if the conditions taken as indicative of nutritional deficiency be really such.

The Vitamin group was not better than the Placebo group at the end of the period of therapy with respect to elevated conjunctival spots, corneal vascularity, and neurological abnormalities, including vibratory sensibility; and was only slightly so with respect to conjunctival thickening, follicular hyperkeratosis and tongue conditions. Of the three positive results, only that on conjunctival thickening may be taken as established by the comparison of strictly comparable data obtained at the beginning and at the end of the Study, the other two positive results are admitted to be only suggestive. More important than the slight positive results, established or suggested, is the persistence of most of the alleged signs of nutritional deficiency in the Vitamin subjects to the end of the Study year. These, accordingly, must be considered either irreversible or not the result of nutritional deficiency. They may not be construed as evidence of currently existing deficiency. As they do not appear to affect the subjects, the burden of proof is on those who would ascribe to these conditions any morbidity significance. Such proof, adequately confirmed, has not yet been presented.

The foregoing summary and interpretation take no account of the improved industrial morale in the Vitamin group; on this point the evidence is conclusive. The improved morale manifested itself in measurable, objective behavior. It was superimposed on a psychotherapeutic effect and, on the evidence, must be taken as a therapeutic effect of the vitamin supplement. Hence there must have been an organic basis of nutritional deficiency or of suboptimal nutritional status, whether detectable by present clinical or instrumental methods or not. It is well known that chronic disease requires long treatment, and it is not excluded that a longer period of therapy than in this Study may have cleared up many more, if not most, of the abnormal conditions observed on the conjunctiva, skin, and tongue.

The interpretation from the other point of view is that all the

positive results found in the Study, on industrial morale, conjunctival, skin, and tongue conditions fit consistently into a general interpretation that in the great majority of the subjects the signs observed were manifestations of mild, but prolonged, previous deficiency. The therapeutic response in such conditions is very slow. Even symptomatic improvement in terms of feeling better, which in acute deficiencies comes quickly with appropriate therapy, was sufficient to affect the behavior of our subjects only after a number of months, which is evidence of the chronicity of their condition. The concept of chronic and acute deficiency states as formulated by Kruse (39) is consistent with the finding of marked improvement or cure of physical signs in only a small percentage of cases, even for those signs for which positive results were obtained. In vitamin A deficiency, follicular hyperkeratosis is a later sign than conjunctival changes; every person in the Study exhibited the latter condition and not all the former. The follicular hyperkeratosis showed a somewhat better response or quicker response than the eye lesions. Conjunctival spots did not disappear, but as these are areas of greater elevation than the surrounding tissue they will continue to be so until repair of tissue is nearly complete. In the case of tongue changes nearly every person had furrows or fissures, a moderately advanced chronic state, and this sign did not respond to therapy. Redness and hypertrophied papillae frequently are associated with a subacute process and therefore the therapeutic response was more rapid and more definite. More prolonged therapy would have enlarged the demonstrable improvement.

Against this interpretation it must be pointed out that in the three therapeutic tests from which firm conclusions could be drawn (in which the data of the examinations at the beginning and at the end of the Study are strictly comparable), *i.e.*, conjunctival and corneal conditions and vibratory sensibility, there was only slight improvement in conjunctival thickening, much less

than might have been expected from the observations of Kruse, and no improvement was found in conjunctival elevations, corneal vascularity, and impaired vibratory sensibility.

The failure of conjunctival spots to respond is inconsistent with the "theory"; these are a later lesion[11] in xerosis than opacity; reports on healing in cases of Bitot's spots indicate that the first stage in repair is fragmentation of the spots (which is in accord with Kruse's conception that the sign last to appear is the first to disappear in therapy). Yet no change in the spots was observed. No firm conclusions may be drawn from the other positive results, *i.e.*, on follicular hyperkeratosis and tongue conditions, because the data on the first and second examinations are not comparable, and as has been emphasized, they may be taken only as suggestive. The definitely negative results on corneal vascularity and vibratory sensibility remain unaccounted for.[12]

The crucial point is whether or not a more prolonged period of therapy would have enlarged the demonstrable improvement. The expectation that this would be the case is based on the work of Kruse. It needs confirmation. Our results are suggestive, they are far from proof, and they emphasize the need for very long time studies on humans and on animals in which similar chronic deficiency lesions have been produced before conclusions may be drawn.

Tests Proposed for the Diagnosis of Mild Nutritional Deficiency

We shall exclude entirely from the following discussion the diagnosis of severe nutritional deficiency, and confine it to those

[11] In a private communication, Kruse expresses disagreement with the view that spots appear late in the development of xerosis conjunctivae. Instead, the area of the spot is the site of early change and the one most severely affected; in chronic deficiency, the lesion progresses and opacity usually develops over an increasing area of the conjunctiva. Under therapy, healing occurs in the reverse order. In this connection, it should be mentioned that in this Study elevated "spots" were noted in cases showing all different degrees and extent of translucency and opacity.

[12] *See* discussion above in the section "Evidences of Thiamin Deficiency."

cases where the diet and medical history may indicate the possibility of a mild, chronic deficiency.[13]

There are, in general, two different circumstances in which diagnostic tests are needed. One is in the treatment of an individual patient in a physician's office or hospital where even a tentative diagnosis is useful as a guide to therapeutic trial. The therapeutic trial is of an abnormal condition which has been proved to be remediable by the therapy to be used, *i.e.,* the abnormal condition is reversible.

The results obtained in our Study indicate that mild forms of follicular hyperkeratosis, and possibly acne, appear to offer some promise of a positive response to massive doses of vitamin A continued for a number of months. In a small per cent of cases there may also be some lessening of conjunctival opacity and thickening. In the majority of cases, vitamin A therapy will not affect these conjunctival conditions within a period of a year or less.

Abnormal coloration of the tongue, hypertrophy or edema of the tongue, and abnormalities of the lingual papillae (observed with the biomicroscope) appear to offer some promise of a favorable response to vitamin B complex therapy.

The following conditions, according to our experience, will not respond to one year's therapy by the vitamins tested in the Study: localized elevations of the conjunctiva, absent reflexes, parethesias and dysesthesias, impaired vibratory sensibility, corneal vascularity, mild anemia, ocular and gastrointestinal discomfort.

The other circumstance in which diagnostic tests of nutritional deficiencies are needed is in surveys of nutritional status. Ideally the tests used would enable distinction to be made between signs of current, *i.e.,* active deficiency states and those which may be designated as passive, *i.e.,* where the deficiency which precipitated the sign in question no longer exists. As many or all of these

[13] For the sake of clarity our conclusions are stated here with a minimum of qualification. The qualifications are discussed in preceding reports with the detailed presentation of the data.

signs do not affect the individual noticeably, knowledge of their long-time morbidity significance, whether they be active or passive, would be of great value. The available tests and knowledge fall far short of these ideal specifications.

Nevertheless enough work has been done for a useful beginning to be made. Our experience in the Study suggests the following specifications as a practical working basis. A *sine qua non* is confirmed evidence that the sign appears in nutritional deficiency states, or evidence that it responds favorably to therapeutic trial. Its usefulness, even when it satisfies these conditions, is in proportion to its specificity. Still another condition needs to be satisfied: when a sign of a specific deficiency is found in a population there should be a good correlation between it and the prevalence of the related dietary deficiency. On the other hand, a wide prevalence of the sign in a population where diet is not deficient in the nutrient in question need not, for the present at least, be held too strictly against the validity of that sign, because it is possible that the deficiency had occurred some time before and the subsequent diet did not contain enough of that nutrient to repair the tissue damage, for which therapeutic doses would be needed.

Of all the diagnostic signs employed in this Study, follicular hyperkeratosis most nearly meets the above requirements. Moult (17) found follicular hyperkeratosis to occur in rats on a vitamin A intake several times that required for a normal growth rate. A relatively high prevalence has been found in surveys of populations in England (18), in Newfoundland (6), and in Tennessee (19); the allied condition of follicular conjunctivitis has been found in American school children (20).

No correlation was found between the prevalence of the dermatosis and plasma vitamin A levels by Youmans *et al* (19) and by Milam and Anderson (21). Nevertheless, Youmans *et al* expressed the opinion,

> It is true that at best the dermatosis is not pathognomonic. It is

however a sign of considerable reliability and meaning when properly applied.

Our findings suggest that abnormalities of the tongue may be a useful sign of mild or moderate nutritional deficiency. There are stronger indications to this effect in the more adequate studies on this point of Kruse (22) and of Sevringhaus and Kyhos (23). Abnormalities of the gums may prove so also (24, 25).

In different population groups, other deficiency signs which we did not study or test may be useful, *e.g.*, subnormal stature (26, 27), faulty bone structure (27), mild anemia because of protein or iron deficiency (28, 29). They need to be studied further in this connection.

The foregoing appear to be useful guides to the recognition of active mild or moderate nutritional deficiency states.

No other clinical signs have won any confidence among the consensus of investigators of populations living on diets whose quality was intermediate between that generally recommended and of those known to precipitate signs of severe deficiency (19, 21, 30-36). Though our findings are in accord with theirs we would not subscribe, at present, to the firm negative conclusions drawn by some workers.

In most of the studies reporting negative results, the tests employed were used with the expectation that they were of active deficiency states. When no correlation was found between the prevalence of the sign in question and the quality of the diets (usually the sign was found in many individuals whose diets were not considered deficient in the related nutrient), it was concluded or inferred that the sign had no nutritional morbidity significance, past, present or future; which is not warranted for reasons discussed above.

There is need for further investigation of pathological conditions which appear during a period of severe deficiency, are specifically associated with that deficiency, and are removed by thera-

peutic but not by normally adequate nutritional amounts of the deficient nutrient—but, if not treated adequately, do not respond, after a time, even to therapeutic doses. Subnormal size in rats has proved to be such a phenomenon (37). Aykroyd (38) observed in patients with beriberi that unless they were energetically treated, foot and wrist drop, localized impairment of tactile sense, and paralysis may become permanent.

Long period studies of mild chronic nutritional deficiencies would be even more important for American and European populations, as such deficiencies are probably by far the most frequent among them. According to Kruse, mild chronic deficiencies are analogous to acute deficiencies in the sense that the resulting pathological conditions require therapeutic doses for a long period for their correction, and this is his explanation of the common finding of stigmata of nutritional deficiency in subjects with amounts of the nutrient in question in their diet and blood which are considered adequate for maintenance of a normal nutritional state (39). It is possible also, as in acute deficiencies left too long without adequate treatment, that mild chronic deficiencies may lead eventually to irreversible changes.

Until more and definite information is obtained on the change from reversibility to irreversibility (relative or absolute) of pathological conditions associated with nutritional deficiency, surveys of populations where only mild nutritional deficiencies are possible or probable will be severely handicapped, and can provide information of only very limited usefulness either to the public health nutritionist or in the treatment of an individual case.

Optimal Versus Necessary Nutrition

The point of departure of this Study was the premise, widely held, that there is a difference between "necessary" and "optimal" nutrition. Among its other purposes, the Study was designed to test the validity, *i.e.*, the demonstrability of the distinction in man. The subjects of the Study were well suited for the purpose.

The word "versus" in the statement of the question (it is in the title of one of Sherman's papers) implies the controversial attitude which has prevaded much of the discussion of it in recent years. In the course of the controversy the implications of the fundamental experimental evidence which gave rise to the question have received little attention, and certain necessary distinctions have been overlooked.

The original and fundamental experiments are those of Sherman and his collaborators extending over the years 1921 to 1945 (40-52). The experimental animal was the rat. The findings may be summarized as follows: The work began with a diet consisting of whole milk and whole wheat which was adequate for a normal rate of growth, adult size and vitality, length of life, and the successful breeding of healthy offspring. Enrichment of that diet by calcium, vitamins A and B_2 (and other nutrients present in larger amounts in milk than in whole wheat), gave a superior rate of growth, greater average adult size and vigor, a longer duration of reproductive life, longer average life, a greatly improved breeding record both with regard to the number and health of the offspring, and superior ability of the offspring to withstand periods of nutritional deficiency. Sherman *et al* stated in 1939,

> As yet, each of our modifications of an already adequate dietary which has increased the length of life has extended the period of adult capacity and vitality rather than the period of physiological old age.

An important consideration in the application of these findings to man was that these "modifications of an already adequate dietary" were well within the bounds of normal and adequate nutrition. It was found later that threefold increase of some nutrients (calcium, vitamins A and B_2), which may be beyond "the bounds of normal and adequate nutrition," continued to produce beneficial results.

The basic diet in the above experiments appears to have been somewhat low in choline and possibly other factors. Using a different basic diet, Waterman and Ammerman (53) found that rats on increasing levels of thiamin, far above that required for normal growth, grew faster and attained greater adult size; and this effect persisted through successive generations maintained on high thiamin levels.

Spector *et al* (54) found that high levels of riboflavin permitted dogs to withstand loss of blood better than a "normal" riboflavin intake.

It is well known in the poultry industry that enrichment of a good diet of hens improves their egg-laying record and the hatchability score of their eggs.

Rapid growth is not always correlated with postponement of senility and longevity (37, 51), with this modification the main conclusion may be taken as established that enrichment of a so-called "normal" diet of animals is beneficial to them and to their offspring. The enriching factors may be natural foods, food concentrates, or synthetic substances.

The beneficial effects observed in the adult animals were relatively small, in some instances they were not seen until the next or successive generations. A "one to one" correlation of differences between single pairs or of small groups of animals did not occur because of the variability of biological material, and, as a result, a statistical analysis of the differences in fairly large groups was required to demonstrate the significance of the differences.

In the application of these findings to human nutrition there is no reason to expect greater or more dramatic effects than are observed in experimental animals. In fact they may be expected to be smaller in view of man's longer life cycle, and his exposure to a variety of unfavorable conditions in his external environment, especially when the enrichment is begun in adult life.

It is this implication of the findings on animals which has com-

monly been overlooked by critics who appear unwilling to accept in experiments on human subjects a difference between experimental and control groups which, though small in an absolute sense, appears to be significant on statistical analysis.

Furthermore there is a need for more precise definition of the terms "normal" or "necessary" and "optimal" nutritional states. Sherman and others judged the "normal" or "necessary" level of nutrition for their experimental animals by arbitrary standards of growth, fertility and longevity; enrichment of diets so designated led to superior performance by these criteria. They made no histological studies to ascertain whether or not their animals, when fed the "necessary" or higher dietary levels, were entirely free of certain pathological changes which are now either proved or suggested to be the result of a nutritional deficiency. Thus, Moult (17) showed that follicular hyperkeratosis occurs in the rat at levels of vitamin A intake several times that required for a "normal" growth rate. Should "normal" or "necessary" nutrition be defined as that in which there is not even minimal tissue pathology of nutritional deficiency origin? And is there an "optimal" nutritional state above such a level? It would be only confusing to attempt to provide answers to these questions by convention.

A more realistic position at the present time and a practical point of departure for future studies would appear to be that pathological tissue changes occur on diets which are sufficient to prevent the classical picture of gross severe deficiency disease. These lesser lesions require special methods for their detection. Sometimes their deleterious effects may be inferred (statistically) from the inferior performance of subjects on such a diet as compared with those on a superior diet. In other instances they appear to have no current deleterious effects, but long period, large scale studies of their possible effects on morbidity are needed before it would be safe to conclude that this is the case. At any rate it is certain that the benefits one may reasonably expect from the cure

of lesser lesions (some of which are considered by some as "normal") are not dramatic nor easily measured. Nevertheless over the whole life cycle or for a nation as a whole they may be profoundly important.

In investigations of the effects of different dietary levels above that required for the prevention of acute or severe deficiency disease it would appear, judging from the work on animals, that the most striking positive effects are likely to be found in children. No positive effects can be expected in adults in a few weeks or months, and the benefits in adults will consist in the arrest or improvement of changes associated with increasing age, *i.e.*, retardation of so-called senile changes.

In such investigations the levels of at least some of the specific nutritive essentials tested need to be carried far above even those of the Recommended Daily Allowances and for long periods, for years. Such studies would furnish data on levels of "optimal" nutrition and of therapy necessary to repair the effects of chronic deficiency. Only those studies on man in which high levels are administered for long periods afford valid comparisons with the experiments of Sherman and others on "optimal" nutrition in animals.

The relevant experiments on man to test the possible effects of dietary enrichment have, on the whole, yielded results which may be considered as positive when viewed from the context of the related animal experiments, and considered simply as the effects of improving a diet which was sufficient to prevent the appearance of a classical picture of severe nutritional deficiency disease, with the definition of the terms "necessary," "normal," and "optimal" left in abeyance. Thus Ebbs *et al* (56) found that pregnant women on "poor" diets which were enriched with a supplement of protective foods and food concentrates had fewer complications during pregnancy and at term, and healthier offspring, than those on unsupplemented "poor" diets. In a number of respects the record

on the supplemented "poor" diets was slightly better than that on "good" diets. Similar results have been obtained in other studies (57-58).

Colby *et al* found that an increased thiamin intake accelerated the mental and physical growth of infants (59). The differences were marked in the first months of life and grew smaller at the end of twelve months.

Beneficial effects of vitamin supplements were observed by Kohn *et al* (60), Harper *et al* (61), and Bransby *et al* (62) in school children and young adults in England during the war years. The three studies did not agree in all their findings, but they were in accord that "endurance" (measured differently in the different studies) was better in the vitamin than in the placebo groups.

Harrell (63) found in a placebo-controlled study that the rate of learning of children receiving 2.0 mg. thiamin daily was greater than those receiving 0.9 mg. daily.

We have referred to the experiments of Keys and his co-workers (9, 64) who found no benefits from increased thiamin or riboflavin intake in young adults performing severe muscular work, neither in the amount of work performed nor in recovery from fatigue. These experiments were relatively short, the longest not extending over a few months, and are, therefore, not pertinent, for reasons discussed above, to the question of whether the findings of Sherman and others on animals occur in man.

Also against them stand the findings of Egana *et al* (65) that some subjects on a vitamin B complex deficient diet supplemented with 36 gm. of yeast daily recovered better from exhausting physical work than in the subsequent period on an unsupplemented "normal" diet.

The findings of Frankau (66) in a series of carefully controlled experiments are in the same direction. The subjects were healthy adult males in the age group 18-32 (R.A.F. air-crew cadets) "in

excellent physical condition." The tests chosen involved both physical effort and coordination; they were severe and called for the utmost cooperation from the subject, whose condition at the end of the test was just short of distress as evidenced by his breathing and pulse rate. The giving of 50-200 mg. niacinamide a few hours or daily for several days before the test, alone or with other vitamins, was followed in every one of six experiments by greater efficiency in the group receiving the vitamins than in the comparable placebo control group. The differences between vitamin and placebo groups were always small, but in every instance they were statistically significant.

Possibly the most promising experiment here is that of Simonson *et al* (8), summarized above. Their findings suggest that a greatly needed bridge may be found between neurophysiological and psychological phenomena. Such a bridge is needed, for example, to analyze the beneficial effect of the vitamin supplement on industrial morale observed in this Study (4).

None of the above studies on human subjects is without shortcomings as proof of benefits conferred by a level of nutritional quality above that designated as "necessary." No studies yet carried out provide even rough estimates of "optimal" levels of one or more specific nutrients for the whole lifetime of men and women and their succeeding generations. Nevertheless, the few studies on man, taken together, suggest that the findings in experimental animals will be found to occur, in some degree, also in man. These experiments, of course, need to be confirmed before any, even tentative, conclusions may be drawn.

Measurement of function, especially of the central nervous system, in different age groups, and of ability to withstand and recover from physiological stress over fairly long periods appear promising. Improvement of function in the central nervous system can occur without demonstrable anatomical changes, and may accompany and thereby provide a measure of the feelings of

well-being. If a bridge can be found between psychological phenomena and measurable physiological functions which parallel the state of well-being, it will be valuable obviously in other studies of human behavior as well as greatly facilitate study of the effects of improved nutrition. The successful application in psychosomatic medicine of Cannon's findings on the physiological concomitants of emotional states is an indication that such a bridge may be found.

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URBANIZATION IN LATIN AMERICA*

ANA CASIS AND KINGSLEY DAVIS

PART II. TRAITS OF THE URBAN AND RURAL POPULATIONS

IF, as Part I has shown, the cities of Latin America already embrace a substantial portion of the population, and if (under the impact of industrialization) they are destined to embrace a still larger portion, the next question is this: What are the leading characteristics of the city populations as contrasted with the rural? What is the nature and extent of the gulf that separates the two? The answer to this question will help explain the process of urbanization in the region. It will also throw light on the future of Latin America, because, with the further diffusion of urbanism, the city characteristics of today will become tomorrow those of the whole country.

Statistics on rural-urban characteristics in the Latin American region are scarce and fragmentary. The data are not always broken down according to the rural-urban difference or according to size of city. For some countries, however, the existing statistics are either satisfactory or can serve as a basis of reasonable estimates. It is thus possible to assemble considerable information on the vital rates, the age distribution, the sex ratio, the marital status, the place of birth, and the literacy of the city and non-city populations. Since the countries for which data exist are scattered and varied, the basic facts about rural-urban differences within these countries seem applicable in a general way to the region as a whole.

We shall try to show that the cities are dependent on the countryside for their people, the countryside dependent on the cities for its cultural advance. First we shall deal with the supply of people, *i.e.*, with the vital statistics—births, deaths, and migration; then

* From the Office of Population Research, School of Public and International Affairs, Princeton University. This is the second part of the paper. The first part appeared in the last issue (April) of the *Quarterly*.

we shall deal with their biological characteristics, such as sex and age, and finally with their cultural traits. We shall find that these topics are all interrelated, and that the facts help to clarify not only the evolution of Latin American cities but also the evolution of Latin America itself.

Vital Rates

Fertility. There can be no doubt that the urban dwellers of Latin America, like those in the rest of the world,[1] have fewer offspring than the rural dwellers. Proof can be found in two independent lines of evidence: First, in the few countries having fairly reliable birth registration, the reported birth rates of the cities are lower than those of the country. Second, in all countries having censuses the urban child-woman ratio is lower than the rural. Both kinds of evidence are subject to error, but the biases would seemingly tend to minimize rather than exaggerate the rural-urban differential. Consequently, the existence of differential fertility may be accepted without cavil.

Reported birth rates for four countries are depicted in Figure 6, the top row of diagrams. In each case, despite some tendency for outlying inhabitants to hospitalize their births and thus report them in the city, and despite better registration in the cities, the urban rates are lower than the rural. Only in Chile in 1941-1943 was the relationship reversed. In general the differential is apparently not so great as in the United States, but this result may be due as much to error as to a real situation; exact comparisons between countries as to rural-urban fertility differences are extremely hard to make. Since Latin America is in an early stage of industrial development, we should expect that the differential between city and country fertility has not yet reached its greatest width. If births were fully reported and were allocated to place

[1] Jaffe, A. J.: Urbanization and Fertility. *American Journal of Sociology*, 48, July 1942, pp. 48-60. Davis, Kingsley: Human Fertility in India. *Ibid:* To be published soon.

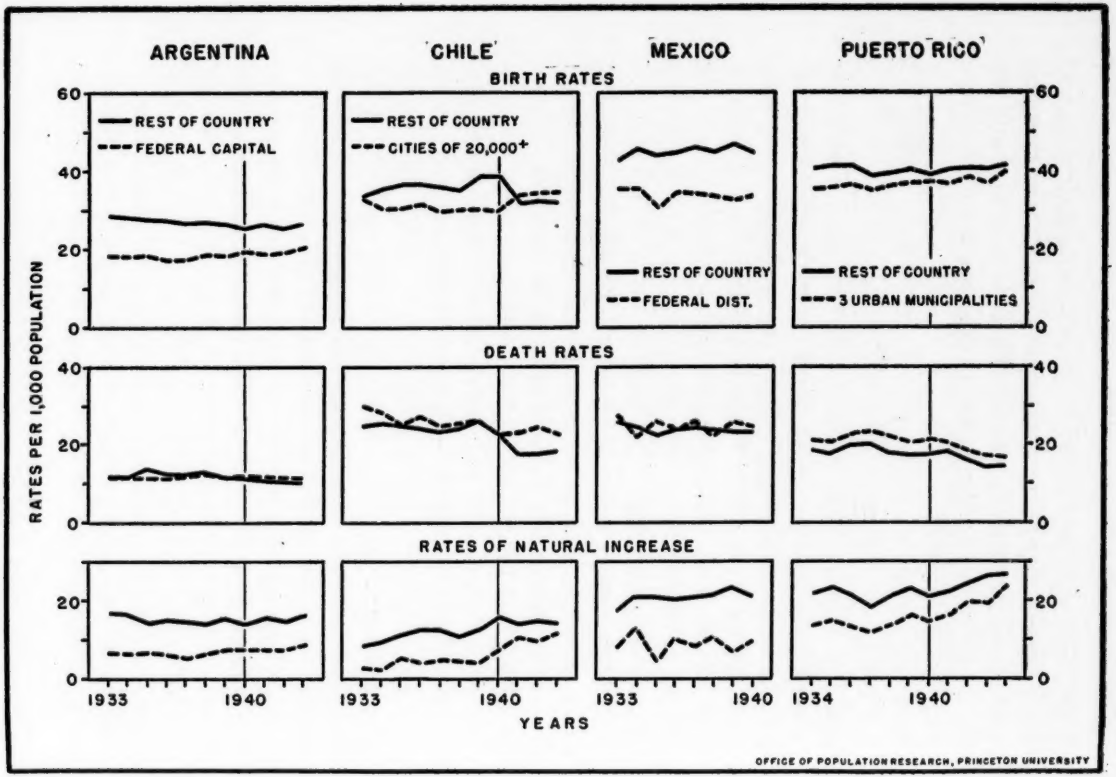

Fig. 6. Vital rates for cities and rural areas in four countries.

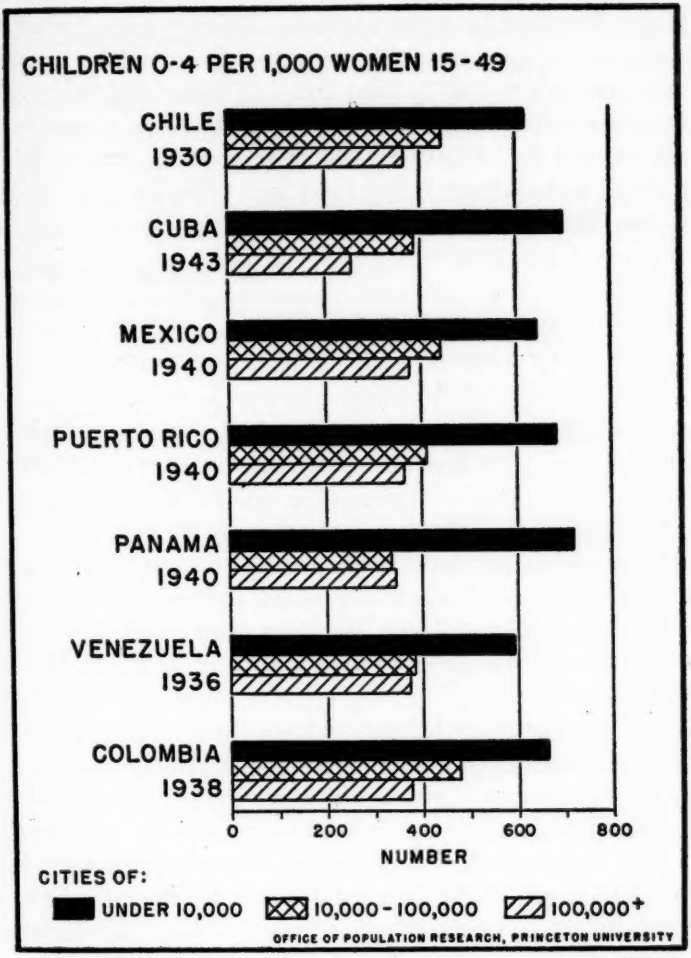

Fig. 7. Child-woman ratios in cities by size class and in rest of country. Selected countries.

Fig. 6. Vital rates for cities and rural areas in four countries.

of mother's residence, the trend in the differential could be accurately gauged.

The evidence furnished by child-woman ratios is as impressive

as that furnished by registered births. Figure 7 gives, for seven countries, the number of children 0-4 per 1,000 women 15-49 in two sizes of city and in rural areas. In every case the urban ratios are substantially lower than the rural, and in general they are lowest in the larger cities. The cities of 100,000 and over have a ratio, on the average, only half as high as do the places under 10,000. Below are given, for the seven countries combined, the

	Children 0-4 per 1,000 Women 15-49 (Seven Countries)
Cities 100,000 Plus	352
Cities 10,000-100,000	412
Places Under 10,000	659

average ratio found in each kind of place.[2] It can be seen not only that the larger cities have the lowest ratio, but also that the difference between them and the smaller cities is far less than the difference between cities in general and the rest of the country. In other words, the gulf between cities of different size is less, in this respect at least, than the gulf between city and country.

One would like to know how long these differentials have prevailed, and whether they have grown or declined. But in addition to the incompleteness of registration and the infrequency of censuses, changes in the habits of hospitalization, of registration, of enumeration, and of presenting the data all frustrate an attempt to get valid statistical series. Historical analysis of rural-urban fertility differentials therefore seems impossible for the present.

Even without the historical data on rural-urban fertility, however, one can rely on the current differential and two other known trends to furnish a prediction that fertility in Latin America will

[2] The censuses from which the figures were derived did not all occur in the same year in these countries. The dates are given in Figure 7. The disparity of date, not great in any case, is not fatal for this kind of average.

The age structure of women 15-49 is not sufficiently dissimilar in the cities and rural areas to justify a refinement of the child-woman ratio on this basis. The large bias lies in the differential underenumeration and mortality of children under 5, not in the distortion of female age distributions within the 15-49 range.

decline in the fairly near future. The two trends are (a) the faster growth of population in urban than in rural areas,[8] and (b) the spread of urban patterns to the rural population. Given the existing differential fertility, these twin processes—urban growth and urban diffusion—will in time lower the birth rate substantially. But there may be still a third factor at work—namely, a secular decline in urban fertility itself. It is this third factor that cannot be proved for Latin America on the basis of present statistics.

The influence of urbanization in lowering fertility seems observable from the figures presented in Table 5. Here the countries are listed according to their urbanization index, and then their reported or estimated birth rates and their child-woman ratios are

Table 5. Birth rates, child-woman ratios, and urbanization index for selected countries.

Country	Date [a]	Urbanization Index[1]	Average Birth Rate	Children 0–4 per 1,000 Women 15–49[1]
Argentina	1943	43.1[b]	25.2[c] [2]	425[d] [3]
Chile	1940	35.8	33.4[e] [2]	528[f]
Cuba	1943	30.5	37.8[g] [4]	535
Panama	1940	23.4	44.8[h] [4]	594
Mexico	1940	19.1	43.8[e] [2]	580
Puerto Rico	1940	17.8	40.0[e] [2]	606
Venezuela	1941	17.4	43.2[i] [4]	593
Colombia	1938	13.3	45.6[j] [4]	628
Peru	1940	13.1	44.3[h] [4]	654

[a] The date in this column refers to columns (2) and (4).
[b] Derived from estimated populations.
[c] 1940–1943 average.
[d] 1938.
[e] 1940–1944 average.
[f] 1930.
[g] 1933–1943 average.
[h] 1930–1940 average.
[i] 1931–1941 average.
[j] 1928–1938 average.
[1] Computed from census returns.
[2] Averages computed from official reports.
[3] Alejandro E. Bunge, Una Nueva Argentine. Buenos Aires: Guillermo Kraft Ltda., 1940, p. 116.
[4] Birth rates estimated by using survival rates, ages 0–9, from roughly applicable Latin American life table to trace the age groups 0–9 back to the births that presumably gave rise to them. Since the census age distributions have not been smoothed, the estimates are probably lower than reality.

[8] *See* Part I, pp. 196-199.

given. It can be seen that there is a fairly good negative correlation between a country's degree of urbanization and its general fertility. In fact the correlation is surprisingly good in view of the ragged nature of the data. The growth of cities and the diffusion of their reproductive habits is already, it appears, having a depressing effect on national birth rates.

Mortality. If the data on fertility are poor, those on mortality are even worse. To judge by reported rates there is no marked or consistent difference between city and country. If anything, as shown in the second row of diagrams in Figure 6, the cities tend to have a higher mortality, but this conclusion must be accepted with care. Obviously the possible advantages run both ways: the cities have better sanitation and more medical service, but they are also more crowded and possibly offer poorer diets. Probably the registration of deaths is much better in the city, and the death rate is artificially increased by deaths of rural people in urban hospitals. Unfortunately there is no measure of rural-urban mortality independent of the reported figures—nothing comparable, that is, to the child-woman ratio. Until further evidence is in, it seems safe to say that the rural-urban difference in mortality is less than the difference in fertility, and possibly has an opposite direction.

Natural Increase. If the cities manifest a birth rate lower than, and a death rate equal to or higher than the country, their natural increase will fall considerably below that of the rural areas. This seems to be the case with the four countries presented in Figure 6 (bottom row). Here the natural increase in the urban areas has ordinarily been between a third and four-fifths of the rural figure. It should be borne in mind that the "urban" population, for the purpose of this chart, is represented only by the Federal District in Argentina and Mexico, only by the three major cities in Puerto Rico, and only by the cities 20,000 and over in Chile. Nevertheless, the magnitude of the differential suggests that in general the

rural population enjoys a rate of natural increase far superior to that of the urban population.

Rural-Urban Migration

Granting the correctness of these results concerning vital rates, we reach the conclusion, mentioned in Part I, that the faster growth of urban than rural population in Latin America has been due primarily to rural-urban migration, and not to a higher natural increase in urban zones. This conclusion is buttressed by a study of those population characteristics that reflect migration.

In Chile it is possible to compare the natural increase of the population in places of 20,000 and over and in the rest of the country with the actual population growth in each of these zones. Theoretically, the figures should run as follows:

Cities 20,000 and Over
Population Growth less Natural Increase = in-migration
Rest of Country
Natural Increase minus Population Growth = out-migration

The in-migration to the cities and the out-migration from the country should approximately equal each other. Actually, because of great under-registration, much late registration, and some foreign immigration, this is not the case. The data are sufficient, however, to permit estimates to be made for the 1930-1940 decade, and from these it appears that more than 50 per cent of the growth of the population in cities 20,000 and over is due to rural-urban migration. The rest of the country apparently lost about 17 per cent of its natural increase to the cities. Since the decade in question was a period of severe depression for Chile, we may assume that this rural-ruban movement was not exceptional.

In Puerto Rico there are three centers of urban concentration—San Juan-Rio Piedras, Ponce, and Mayaguez. By computing natural increase and population increase for the four municipalities

containing these centers,[4] it is possible, as in the case of Chile, to form an estimate of the migration into these centers, which can be checked by forming an estimate of the migration *out* of the other municipalities. The results indicate that no less than 61.5 per cent of the population gain in the four municipalities was due to in-migration, while the rest of the island lost approximately

Table 6. Per cent of total population and per cent of foreign-born in specified urban areas.[1]

Country and Urban Areas	Census Date	Per Cent of Total Population in Urban Area	Per Cent of Foreign-Born in Urban Area
Argentina	1914		
Capital Federal		19.8	32.5
Places 1,000 Plus		57.4	68.3
Chile	1930		
Santiago and Valparaiso		21.5	55.9
Cities 10,000 Plus		34.7	77.9
Colombia	1938		
Urban Municipios[a]		10.5	47.5
Cuba	1943		
City of Havana		13.8	30.8
Cities 10,000 Plus		35.7	50.1
Jamaica	1943		
Kingston–Port Royal, and St. Andrew Parishes		19.3	56.0
Mexico	1940		
Federal District		14.6	28.6
Panama	1940		
Panama City and Colon		24.8	72.5
Peru	1940		
Lima and Callao		14.7	62.6
Puerto Rico	1940		
City of San Juan		9.1	44.0
Places of 2,500 Plus		30.3	76.2

[a] Includes only those municipios having 70 per cent of their population in cities of 10,000 and over.

[1] Computed from census returns.

[4] The only one of the four municipalities that is not mainly urban is Rio Piedras, but it has a density of 1,240 per square mile (1940) and is the main area of expansion from San Juan, which is entirely urban.

29 per cent of its natural increase. These findings are roughly similar to those for Chile. It seems correct to say that throughout Latin America the rapid growth of cities is due in large part to rural-urban migration.

Not only does internal migration contribute heavily to city growth, but in some areas foreign immigration does the same. In this region, as elsewhere, immigrants have tended to settle in the cities rather than in the country.[5] Evidence of this has already been presented in Part I, but the material is now brought together in tabular form in Table 6. In all the countries examined the immigrants are concentrated in the urban parts and particularly in the larger cities.

Age Distribution

The age structure of the cities reflects both their lower fertility and their greater attraction to migrants. As compared with the country, the cities have a deficiency of children and an excess of adults. In Table 7, for example, there are six countries for which the proportion in broad age-sex groups is given as a percentage of the proportion found in the general population. (*See* also Figure 8.) It will be noticed that in both small and large cities there is, in addition to a low percentage of children, a heavy concentration of males and females in the age class 15-49. The concentration is somewhat greater in the larger cities, but as between males and females it is approximately equal. In the age group 50 and over, however, the concentration is greater for small cities than for large, and much greater for women than for men. Apparently, then, there is a tendency for the cities to attract both men and women in the vigorous period of life, and the larger cities exert a greater pull than the smaller ones. In the later adult ages

[5] For the Brazilian situation, *see* Smith, T. Lynn: Brazil: People and Institutions. Baton Rouge, Louisiana State University Press, 1946, pp. 199-200. For the world situation *see* Forsyth, W. D.: The Myth of the Open Spaces. Melbourne, Melbourne University Press, 1942, Chs. 3 & 6. The case of Buenos Aires and other Latin American cities was mentioned in Part I, pp. 199-200.

the pull is not so great for males, especially in the larger cities; but it is just about as great for females. In the older ages there is a heavy concentration of females, greater than is found in Canadian cities. This concentration of elderly women in Latin American cities is possibly due to greater employment opportunities there, especially in domestic and other service occupations. It may also reflect a tendency to live with urban rather than rural relatives when both are available.

Professor T. Lynn Smith, who has noted similar age phenomena in Brazil, has this to say: "In general . . . the age profiles of Brazilian cities are of the type that arises where rural-urban migration is a one-way process. There is little evidence to indicate that persons who have moved to the cities in early life, later seek a

Table 7. Per cent which city age distributions form of the total country. (Proportion of total country in each age group = 100.)

Size of City and Country	Date of Census	Under 15 Both Sexes	15–49		50 and Over	
			Males	Females	Males	Females
Cities 10,000 to 100,000						
Chile	1930	92.5	106.6	106.5	92.2	97.2
Colombia	1938	87.3	110.7	110.9	92.3	108.7
Mexico	1940	90.1	104.5	106.7	106.3	115.4
Panama	1940	63.6	123.0	122.0	137.0	116.8
Puerto Rico	1940	83.5	108.7	112.1	104.3	123.6
Venezuela	1936	82.3	112.9	109.9	100.4	125.0
Average—6 Countries		*83.2*	*111.1*	*111.4*	*103.4*	*114.4*
Canada[a]	1941	79.2	109.5	110.4	101.8	104.0
Cities 100,000 Plus						
Chile		83.7	111.6	113.1	87.4	104.5
Colombia		79.7	116.2	118.2	86.8	112.2
Mexico		82.8	113.8	114.4	88.1	110.2
Panama		73.0	120.4	118.7	103.1	111.6
Puerto Rico		78.8	116.0	116.6	95.9	113.5
Venezuela		81.8	114.8	108.4	100.6	129.1
Average—6 Countries		*80.0*	*115.5*	*114.9*	*93.6*	*113.5*
Canada		81.9	106.2	108.7	103.4	108.0

[a] Cities 20,000 to 100,000.

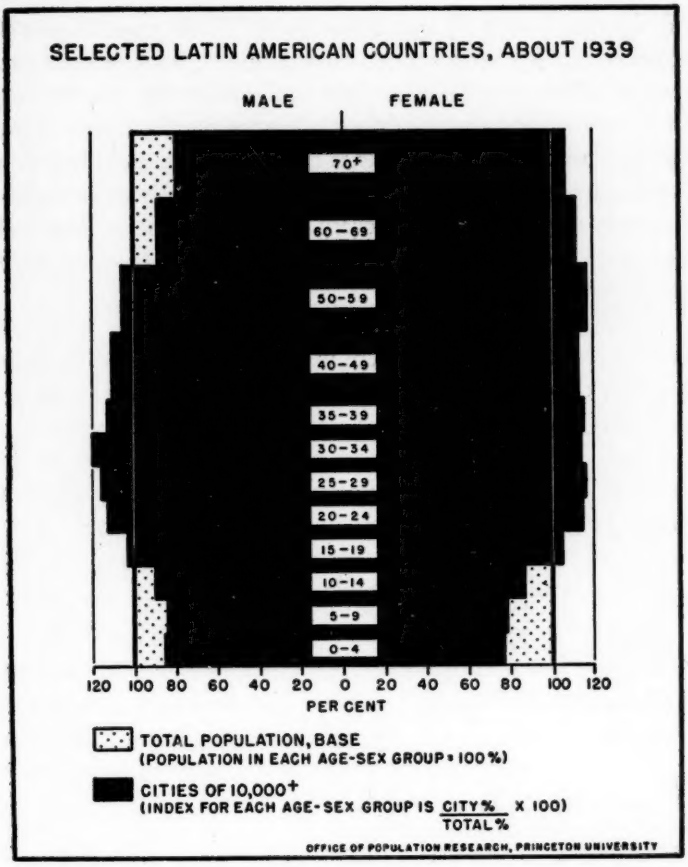

Fig. 8. City age distribution compared with total population.

home on the land in which to spend their declining years, as is prevalent in the United States and some of the European countries."[6]

Sex Ratio

The concentration of women in the cities occurs not only at

[6] *Op. cit.*, pp. 210-211.

elderly ages, but at all ages above 15. In Table 7 and Figure 8, however, the sex ratio cannot be determined, because each percentage relates to a given sex, not to the other sex. In Table 8, on the other hand, the sex ratio is given for the population above age 15. In all of the six countries except Panama (which is in a peculiar situation) the rural sex ratio is substantially more masculine than the urban, and in every case except Puerto Rico and Venezuela, the small city ratio is more masculine than the large city ratio.[7]

The accumulation of women above age 15 is exactly what one would expect. In an area where urban growth is based on light industry, commerce, political centralization, and leisure-class interest, and where the rural areas sadly lack civilized conveniences, short-run rural-urban migration would normally tend to be feminine in character. This is not the case in India, where a different kind of culture has produced cities that are dominantly masculine, but it is the case in Western lands. In this matter the Latin American countries resemble the United States and North-

Table 8. Males per 100 females in population aged 15 and over, for cities by size class and rest of country.

Country and Census	Census Date	Places Less Than 10,000	Cities 10,000 to 100,000	Cities 100,000 and Over
Chile[a]	1930	104	91	80
Colombia[a]	1938	98	86	76
Mexico[b]	1940	98	81	77
Panama	1940	107	119	100
Puerto Rico	1940	106	82	84
Venezuela[a]	1936	93	80	86
Canada	1941	110[c]	98[d]	96

[a] In Chile, Colombia, and Venezuela the characteristics of the population of cities are not given. Instead, the population characteristics are given for the comunas, municipios, or distritos. We took those units that had 70 per cent or more in the city and assumed that their characteristics were practically the same as those of the city that each contained.
[b] Includes only 22 out of the total of 32 states.
[c] Places less than 20,000.
[d] Cities 20,000 to 100,000.

[7] Smith, *op. cit.*, pp. 215-216, finds that the capital of each state in Brazil had, on the average, a lower sex ratio than the rest of the state, according to the 1920 census.

western Europe, except that there appears to be less variation from city to city in the Latin American region. In the United States the sex ratio of the cities varies markedly according to the type of industry,[8] but on the whole the cities of Latin America are not yet so occupationally specialized. The main disturbances to the sex ratio appear to come as a result of foreign immigration.

Marital Status

Usually in the city, as compared to the country, people marry later and less frequently. Certain peculiarities of Latin American culture, however, appear to reverse this pattern (Table 9). In a country such as Venezuela, for example, a greater percentage of persons aged 15 and over in the city are married than in the country. But the key to this situation lies in the term "married." The Venezuelan census does not give figures on the number of consensual unions—*i.e.,* unions entered into without a formal marriage and capable of being broken without a formal separation or divorce.[9] Presumably it classifies people in such unions as "single," although probably some of them slip into the "married" column. If, on the other hand, we take a country that does give figures on consensual unions, we find that the proportion of persons living together, whether in wedlock or in consensual union, is greater for the rural areas than for the city. In Panama, for instance, the figures are as follows:

	Per Cent Living in Marriage or in Consensual Union			
	Males		*Females*	
	15-49	*50+*	*15-49*	*50+*
Cities of Panama and Colon	42.0	59.1	47.4	33.3
Rest of Country	46.1	62.4	56.7	35.4

[8] U. S. Bureau of the Census, Sixteenth Census of the United States, Population, Vol. II, Characteristics of the Population, Part I, p. 116. For regional differences *see* Vance, Rupert B.: All These People. Chapel Hill, University of North Carolina Press, 1946, Ch. 4.

[9] The Cuban census of 1943, pp. 767-68, in accordance with the 1940 Constitution, did not inquire into the legality of the union, but the census authorities believe that most persons living in consensual union were listed as "single" and in the comparative tables of this

(Continued on page 308)

Table 9. Per cent in each marital status, by age and sex, urban areas and rest of country, selected countries.[1a]

	Males		Females	
	15–49	50+	15–49	50+
Argentina 1914[a]				
Federal Capital				
Single	50.3		38.6	
Married	46.6		50.2	
Widowed	3.1		11.2	
Rest of Country				
Single	55.2		43.1	
Married	40.9		47.2	
Widowed	3.9		9.7	
Chile 1930				
Cities 100,000+				
Single	52.8	12.6	47.9	18.9
Married	45.2	70.2	45.8	31.7
Widowed	2.0	17.2	6.3	49.4
Rest of Country				
Single	59.2	16.5	49.6	17.1
Married	38.8	66.2	46.1	43.3
Widowed	2.0	17.3	4.2	39.6
Colombia 1938				
Cities 100,000+				
Single	64.1	19.7	62.3	34.4
Married	34.7	67.6	32.9	27.4
Widowed	1.2	12.7	4.8	38.3
Rest of Country				
Single	65.2	22.2	58.1	30.7
Married	33.2	65.1	37.7	35.5
Widowed	1.6	12.7	4.2	33.8
Cuba 1943[b]				
Province of Havana				
Single[e]	64.3	26.5	53.0	22.7
Married	34.0	60.6	42.3	41.8
Widowed	.9	11.8	2.9	33.9
Divorced	.8	1.2	1.8	1.6
Rest of Country				
Single[e]	74.9	33.6	65.2	27.7
Married	24.0	55.2	32.3	43.6
Widowed	.8	10.6	2.0	28.1
Divorced	.3	.5	.6	.6
Jamaica 1943				
Kingston, Port Royal and St. Andrew				
Single	53.0	20.0	56.7	34.6
Married	25.3	58.0	23.5	30.6
Consensual	21.1	12.6	17.4	2.9
Widowed	.4	9.1	2.2	31.6
Divorced[d]	.2	.4	.2	.3

Table 9. (Continued)

	Males		Females	
	15–49	50+	15–49	50+
Jamaica (Cont.)				
Rest of Country				
Single	58.9	20.7	52.4	32.6
Married	20.2	57.5	24.0	36.5
Consensual	20.4	12.8	21.9	4.6
Widowed*	.5	9.0	1.7	26.3
Mexico 1930[f]				
Federal District				
Single	43.6	9.9	42.1	16.1
Married	40.8	50.6	32.3	12.7
Consensual	13.1	7.3	10.8	2.2
Widowed	2.4	23.0	14.4	68.7
Divorced	.2	.2	.4	.3
Rest of Country				
Single	34.3	6.0	31.7	11.9
Married	47.4	60.3	44.2	23.8
Consensual	14.8	11.1	13.8	4.8
Widowed	3.2	21.9	9.8	58.8
Divorced	.4	.7	.5	.6
Panama 1940				
Panama City				
Single	57.4	28.8	50.2	33.6
Married	23.0	44.4	24.6	24.0
Consensual	18.5	17.3	21.2	7.1
Widowed	.7	8.7	3.4	34.4
Divorced	.4	.8	.6	.9
Rest of Country				
Single	53.4	30.1	41.1	37.0
Married	16.3	32.0	20.1	21.0
Consensual	29.3	29.3	35.9	15.2
Widowed	.8	8.3	2.6	26.3
Divorced	.1	.3	.3	.5
Venezuela 1936				
Cities 100,000+				
Single	70.4	29.8	64.8	44.3
Married	26.4	56.0	28.7	20.0
Widowed	1.7	13.3	5.6	35.2
Divorced	.5	.8	.9	.5
Rest of Country				
Single	79.0	41.6	73.9	54.2
Married	18.9	45.0	21.9	19.3
Widowed	1.8	13.0	3.9	26.2
Divorced	.2	.4	.2	.2

* Argentina, Chile, and Colombia do not give any data on divorce.
[a] Argentina gives data only for "15 years and over" combined.
[b] The breakdown below age 50 for Cuba is 14–49.
[c] Includes single, consensual union, and unknown.
[d] Includes divorced and "not specified."
[e] Includes widowed, divorced, and "not specified."
[f] The breakdown by age for Mexico for Males is 16–59 and 60+; for Females, 14–59 and 60+.
[1] Computed from census data of the given date.

Thus the apparent reversal of the urban tendency toward late and infrequent marriage is not a real reversal. This fact must be borne in mind in interpreting Table 9. But the fact that a larger proportion of people living together in the city are officially married indicates once more that the city is ahead of the country in cultural advance. It is the backward and out-of-way areas that have the highest proportion of consensual union. As the influence of the city spreads, the amount of consensual mating will probably decline. At the same time, the formation of effective reproductive partnerships of all kinds, legal or non-legal, may also decline.

As might be expected, the proportion of persons widowed and divorced is also greater for the city. The tendency of widows to concentrate in the city is very apparent, although there is no such tendency for widowers.

Legitimacy

If more of the city people are "married" in comparison to the country, it follows that more of the city births will be "legitimate." This actually turns out to be the case in the few countries for which the data could be found (Table 10). Most of the so-called illegitimate children are of course merely the offspring of consensual unions. What the proportion is, and what the rural-urban differences are with respect to offspring of promiscuous relations, nobody knows. It is possible that such promiscuous illegitimacy is more frequent in the city than in the country. As for recorded illegitimates, the rural-urban difference appearing in the statistics is probably a minimum, because the registration may be poorer for illegitimate births in general, and for those in the country in particular.

Census they were so treated. In Chile, where also no inquiry was made, it is thought, on the other hand, that most of those in consensual unions recorded themselves as "married" (Census of 1930, Vol. II, p. ix). Colombia also made no attempt to get data on consensual unions, and hazards no guess as to how they were returned (Census of 1938, Vol. VII, p. xi). For a treatment of the institution of concubinage in Latin America, *see* Davis, Kingsley: Contemporary Modes of Marriage *in* Becker, Howard and Hill, Reuben: Marriage and the Family. New York, Heath, 1941, pp. 100-06.

Literacy

Another evidence that the cities are in the van of cultural change in Latin America is the fact that the urban populations show a considerably higher literacy than the rural (Table 11). In some cases (*e. g.*, Mexico and Panama) the literacy in places of more than 10,000 is twice that of the rest of the country. In others (*e. g.*, Chile and Puerto Rico) the difference is much less. Apparently the Latin American countries are in an intermediate stage so far as literacy is concerned. The cities are not completely literate as yet, but they are beginning to approach that condition. In the meantime, the countryside lags behind and promises to catch up only after the lapse of some years.

Table 10. Per cent of registered births that are illegitimate, by cities and rest of country.[1]

Country and Area	Per Cent Births Illegitimate
Chile 1940–1943	
Cities 100,000+[a]	20.1
Rest of Country	25.5
Mexico 1937–1939	
Federal District	30.9
Rest of Country	37.9
Venezuela 1940–1944	
Federal District	48.6
Rest of Country	61.9
Cities 100,000+ 1939–1940	46.8
Cities 10,000+ 1939–1940[b]	52.9
Peru, July, 1941–June, 1943	
Lima and Callao[c]	43.4
Rest of Country	45.7

[a] Includes Santiago, Valparaiso, and Viña del Mar.
[b] Includes only eleven out of the sixteen cities listed by the 1936 census in this size class. The cities included, however, represent 84.7 per cent of all cities 10,000+ in 1936.
[c] Includes the entire province of Callao and the entire department of Lima. Data for cities are not available.
[1] Data taken from official reports.

Literacy does not necessarily increase with size of city. As Table 11 shows, the cities below 50,000 generally manifest a lesser literacy than those above 50,000, but once this point is passed an increase in size of city does not consistently mean a higher literacy. Perhaps the largest cities have the heaviest rural-urban migration and therefore draw a larger proportion of their citizens from the relatively illiterate countryside.

A question important for estimating future social development can now be raised: Is literacy increasing faster in the cities or in the country? If it is slower in the country, we may expect future improvements in general literacy to take painfully long. One commonly hears, indeed, that education for rural peons means little, because they cannot use it in their elementary pursuits. Such opinions might lead us to expect progress in the country to be slower than in the cities. But according to the results given in Table 12, this is apparently not the case. In four out of five countries having available data, the non-urban parts manifest a higher ratio between literacy age 10-19 and that age 20-plus than do the cities. The only exception, Venezuela, involves merely an insignificant difference between the two ratios. The higher ratio of childhood to adult literacy in rural parts means that, as against the cities, these parts will gain in the future. It *could* mean simply that rural youth, having learned to read and write

Table 11. Per cent literate age 10 and over, for cities by size class and rest of country.[i]

Country	Total Population	Above and Below 10,000		Cities over 10,000		
		—10	10+	10–50	50–100	100+
Chile 1930[a]	73	65	87	84	89	88
Colombia 1938[a]	56	53	80	69	84	82
Mexico 1940[b]	46	35	77	72	76	79
Panama 1940	65	50	94	94	—	93
Puerto Rico 1940	68	65	80	76	77	83
Venezuela 1936	36	29[c]	73[d]	•	•	79[f]

[a] Classified as literate: those able to read. For the other four countries the classification includes only those able to read and write.
[b] The percentage for total population is based on data from twenty-six states. Other percentages are based on data from twenty-one states.
[c] Computed by subtracting from the total population the urban districts of Girardot, Maracaibo, Heres, Puerto Cabello, and the Federal District.
[d] Includes the above mentioned districts.
[e] Not available.
[f] Includes Caracas and the whole district of Maracaibo.
[i] Computed from data in census volumes.

in school, later forget this skill more often than urban inhabitants, or that the city draws by migration the more literate individuals from the rural areas. On the other hand, it seems logistically plausible that as the cities approach fairly complete literacy, their percentage increase in literacy will decline, whereas the rural rate of increase will remain high. There is at least one place, Puerto Rico, where recently the rural literacy is known to have grown faster than the urban. Here between 1910 and 1940 rural literacy increased by 145 per cent, urban literacy by only 31 per cent. For various reasons, then, the hypothesis that the rural areas are gaining faster in literacy seems acceptable. This means that the citizens of Latin America are becoming more homogeneous with reference to cultural development, and that the old gulf between hinterland and metropolis is being bridged.

Table 12. Ratio of per cent literate age 10-19 to per cent literate age 20 plus, for cities 10,000 and over and for rest of country.[1]

	Date	Per Cent Literate		Ratio
		Age 10–19	Age 20 Plus	
Cities 10,000 Plus				
Chile[a]	1930	91.9	84.8	1.08
Mexico[b]	1940	75.1	77.3	0.97
Panama	1940	97.5	92.4	1.06
Puerto Rico[c]	1935	88.8	71.1	1.25
Venezuela	1936	70.3	74.6	0.94
Rest of Country				
Chile[a]		72.5	61.9	1.17
Mexico[b]		39.9	34.1	1.17
Panama		63.9	43.9	1.46
Puerto Rico[c]		78.6	48.4	1.62
Venezuela		27.0	30.0	0.90

[a] Literates include also those able to read but not write.
[b] Estimate required to get this age breakdown. Ratio of literates 15–19 to those 15–39 in Mexico was assumed to be the same as in Panama.
[c] Urban population defined as that living in cities and towns, rural population as that living out of cities and towns. "Cities and towns" includes some places of less than 2,500. *See Census of Puerto Rico*, 1935, Bulletin 2, p. 1.
[1] Data taken from relevant census volumes.

Language

One of the reasons for the country-city gap in literacy, at least in Western South America and Central America, is the concentration of Indians in rural sections. Generally if a person speaks an Indian language as his native tongue he is not literate, because Indian languages have not usually been made a medium for popular written communication. Also such a person is generally in a rural section, because it is in the outlying parts that Indian culture has persisted. Consequently, the greater the proportion of a nation's inhabitants speaking an Indian language, the larger the gap between rural and urban literacy. In Table 12, for example, the largest gap is found in Mexico where there are many Indians, and the smallest in Puerto Rico where there are none. In countries having large Indian populations (*e.g.,* Mexico, Guatemala, and Peru) there is, by departments or states, a strong correlation between the percentage speaking an Indian language and both the percentage illiterate and the percentage rural.

The census publications do not give much attention to language, and when they do include it, they do not always break down the data on the basis of rural and urban categories. But it seems safe, on the basis of available information, to say that the Indian-European dochotomy is one of the factors helping to create a gulf between country and city in Latin America.

Conclusion

Founded by Europeans and serving as links with the outer world, the cities of Latin America have grown rapidly. They have grown, not because of heavy industrialization as in most other regions, but because of water-borne foreign commerce, political centralization, and large-scale land ownership. They have reflected foreign influence to a high degree, and consequently have been separated from their own hinterlands by a wide cultural gulf. The extent of this gulf is revealed clearly by the char-

acteristics of the urban and rural populations. In every way (with the possible exception of risk of death) the city traits are closer to those associated with modern industrial civilization, even though heavy industry is still largely absent.

The urban population has a markedly lower fertility and a lower natural increase. Its more rapid growth, therefore, is due to a heavy rural-urban migration. This migration does not take away all of the natural increase of the agricultural areas, but it undoubtedly helps to postpone pressure in these areas; and it apparently contributes 50 per cent or more of the city growth. As a result of the low birth rate and the heavy intake of migrants, the cities have a concentration of persons in the productive ages. Also, because the cities perform primarily commercial, political, and cultural rather than industrial functions, their adult sex ratios are predominantly feminine. The migrants, especially the female migrants, tend to stay in the city rather than return to the country in old age.

In apparent contradiction to other Western experience, the Latin American cities show a higher proportion of married persons than do the rural sections. When, however, the consensual unions are taken into account, the proportion of mated persons is lower. "Illegitimacy" is definitely lower in the cities, but again this largely arises from the lower proportion of consensual unions.

The cities are much more literate, in some cases twice as literate. The reasons lie in everything that has served to emphasize the city as against the country, including the concentration of Indians in rural regions, the preference for urban expenditure, and the tendency of immigrants to settle in the cities. It appears from age data and historical analysis, however, that rural literacy will increase faster than urban in the future, and that the gap will thus be reduced.

All told the rural-urban differences are such as one might expect in a region basically Western in culture but still in the industrial

revolution.[10] Such peculiarities as are found arise from the transplantation of Iberian social institutions to the particular geographical and cultural environment of South and Central America. These peculiarities are likely to be temporary, being modified as the process of industrialization accelerates. It is significant that the trend toward urbanization shows no slackening as yet, and that the gap between country and city seems to be narrowing. With further industrialization it seems likely that the cultural characteristics of the cities will soon become those of the rural population, and that the gulf between city and country will eventually become no greater than in the United States today. If in the meantime the Latin American nations can profit by the experience of more developed lands, to hasten and guide the process of industrial advance and urban diffusion, so much the better.

[10] For an analysis of the demographic stage in which Latin America finds itself today, *see* Davis, Kingsley: Population Trends and Policies in Latin America, PROCEEDINGS OF CONFERENCE ON ECONOMIC ASPECTS OF POST-WAR INTER-AMERICAN RELATIONS. Austin, Institute of Latin-American Studies, University of Texas, to be published in 1946.